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BIBLIOGRAPHY OF

Materials related to energy issues in Mongolia

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Bibliography of materials related to energy issues in Mongolia

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Contents

Foreword

Development of any country is directly related to development of its energy sector. Especially in Mongolia with its harsh weather conditions the problem of providing consumers with reliable power and heating has great significance. However, since coal is the main source of energy production in our country, it causes a number of environmental problems, such as air and soil pollution, as well as affects negatively human health. That is why development of more environmentally—friendly energy sources, increasing effectiveness of the energy sector, energy conservation has become a priority. In addition, a problem of energy supply for exploration of large minerals deposits has become a pressing issue to be resolved.

The present bibliography is compiled with an aim to provide information on academic works, books, brochures, articles, thesis, papers, reports of projects implemented by international organizations, recommendations related to energy development issues since 1995 at the time when Mongolia is preparing to finalize a comprehensive policy of the energy sector in line with interests of the national development.

The bibliography is for use by policy makers, researchers, students, donor agencies and everyone, who is interested in the topic. The book is published in Mongolian as well.

We express our gratitude to the research team headed by J.Dorjpurev, who successfully implemented this work on commission of the Open Society Forum and gave an opportunity to hand you this book.

P. Erdenejargal

Executive Director,
Open Society Forum

Instructions on use of the bibliography

One. Materials in the bibliography are divided into following 6 categories:

7. General issues of energy
8. Power
9. Heating
10. Renewable energy
11. Fuel
12. Energy, environment, ecology

Two. Details of materials included in the bibliography

	Indicator	Explanation	Example
1.	*Number*	Numbered according to the category.	4.4— 4th in the "Renewable energy" category
2	*Author's name*	The first name of the author, and the first letter of surname	*Ganhuyag D., Purevdagva N., Ligden M.*
	Year of publica—tion	The year when it was published	*(2008)*
	Name of the work	The name is written in bold, in mother tongue. If it was published on language other than Mongolian, the Mongolian trans—lation is written in brackets after the name.	Results of study on establishment of the wind park, its feasibility, obstacles faced.
	Name of the book or maga—zine where the work was pub—lished	Pages of the book or magazine, where the work is published, are also indi—cated	*Papers of the "National forum on renewable energy" (pp 47—50)*
	Place of publi—cation	Country, city, printing house	Mongolia, Ulaanbaatar

3	*The kind of work*	All works are classified as books, articles, papers, thesis, study reports, project documents.	*Paper*
	Pages	The number of pages in the given work	*4 pages*
	The language of publication	The language of publication	*Mongolian*
4	*Key words*	Main words that can express basic contents of the given work	Wind park, daily regime of wind speed
5	*Brief contents*	Brief contents of the work (research objective, study object, methodology, main conclusions)	The paper presents wind specifics of the Shar hu−viin range and the Salhit mountain.

Three. Example

1.	**4.4**
2.	*Ganhuyag D., Purevdagva N., Ligden M. (2008).* **Results of study on establishment of a wind park, its feasibility, obstacles faced.** *Papers of a National forum on Renewable energy (pp 47−50) Ulaanbaatar, Mongolia.*
3.	*Paper, 4 pages, Mongolian*
4.	*Keywords: Wind park, daily conditions of wind speed*
5.	The paper presents feasibility study results of establishing a Wind park of 50 MWt capacity with use of 2 MW Wind Power turbine depending on wind resource specifics of the Shar Huviin mountain range and the Salhit mountain. A conclusion was made that a need arose to reform a power supply system structure in the Central region of our country by establishing a new Wind park, which produces power in an environmentally friendly way, reducing greenhouse gases and saving clean water and coal. Problems in transportation of heavy, large−size components of the 2 MWt capacity Wind Power turbine from Zamiin Uud to Choir on a vehicle of a special design, transportation of a heavy−duty crane needed for assembly of the WPT were mentioned specifically. Authors also view that some ambiguous articles in the Law on Renewable energy and the Law on Energy obstruct development and implementation of an Agreement on purchase and sale of electric power at international level and restrict legal environment for real investment in this field.

1 General issues of energy

1.1

Asian Development Bank (2002).

Completion Report on the Energy Conservation Project:

http://www.adb.org/Documents/PCRs/MON/pcr_mon_29012.pdf

Project document, 37 pages, English

Key words: Conservation of energy, heat loss, supply of heating

The Project Completion Report on the Energy Conservation implemented on a loan of 10 million US dollars in its last part contains a vivid description of planned and executed measures under this project.

Under this project by introducing monitoring and metering of energy supply efficiency of energy was improved, loss in heat network of heating system was reduced, and a realized demonstration component of it showed how energy could be saved.

As a result of completion of this project substantial savings were made reducing network heat loss to Tcal 79 , consumer net wastage to Tcal 80, technical loss of electricity to GWt 20, other mechanical loss of electricity to 20 Tcal respectively.

1.2

Asian Development Bank (2002).

TA 3299−MON Capacity Building in Energy Planning: Final Report, Volume I: Executive Summary

Electrowatt−Ekono Ltd., Switzerland

Project report, 69 pages, in English

Key words: Energy planning, Energy master plan, capacity building, energy balance

The main objective of this project was to assist the Ministry of Infra−structure in developing a Master plan for development of electricity and heat energy supply of Mongolia for 2001−2020 and improve further the Master plan developed in 1995, assist the Ministry of Infrastructure in its capacity−building effort to carry out research in energy planning on its own. In the framework of this project as a result of research into the future market demand, electricity and heat energy balance up to 2020 has been worked out.

It surveyed, in particular the aimags, the current status of heat generation stations. It reviewed the current situation of heat generation plants, aimag center heat plants and hydro−power stations, defined the need for new sources of electricity and heat as well as expansion of electric transmission lines. It identified heat supply of towns, renewable energy sources to be built in rural areas and developed a project plan to improve energy planning capacity.

1.3

USAID (U.S. Agency for International Development) (2003)

Mongolia's Energy Sector Commercialization and Privatization Program.

World Bank, Washington, USA
http://pdf.usaid.gov/pdf_docs/PNACT980.pdf

A project study repart, in English, 44 pages

Key words: Energy sector, restructuring, energy sector commercialization, privatization, energy prices and tariffs, energy regulations, energy regulating agency, special license holders

The study compiles and evaluates work carried out in the framework of Mongolia's Energy Sector Commercialization and Privatization Program. The study describes objectives of commercialization and privatization program, programs implemented to reform heat and power sector, reform in its legal environment, regulatory reforms, the way the chosen energy companies were commercialized and privatized and a program of privatization in energy sector.

1.4

Batjargal Ts. (2006).

Developing methodology and scientific non−linear mathematical models for investigating Mongolia's energy demands growth and supply.

University of Science and Technology.

Ph. D. thesis abstract, in Mongolian

Key words: Energy consumption, growth dynamics, energy reserve, mathematic model, programming, fuel, energy and power balance

The study researched various levels of uneven consumption of energy in Mongolia and developed a test index to determine dynamics of growth for energy demand in different duration cycles (short, medium, long). A methodology and a mathematical model to determine constructively Mongolia's energy supply and demand growth in market economy were developed during the study. Using mathematical statistics, mathematical models and programming means changes in energy consumption were researched and evaluated and a methodology to improve the balance structure of fuel and energy power was developed.

1.5

Batmunkh S., Enkhjargal Kh., Demberel D. (2007).

Technological Progress in Mongolia's Energy sector, innovations 85.

Mongolia, Ulaanbaatar: Publishing house "BAMBI FOUNDATION"

Book in Mongolian, 380 pages

Key words: Technological progress, innovation, innovators, advanced technique and technology, constructive ideas

The book consists of two main parts, the first part describes innovations in energy and power sector, introduction of technological progress and its development, new progressive technique and technologies introduced in the energy and power sector during last few years, the present situation and future trends in science and technology of the sector. The second part of the book listed innovations and improvements suggested by the innovators of energy and power sector by the date these innovations were recorded in state registry. Altogether 156 innovations are included along with a brief sketch of the authors. At the end of the book a list of some innovative proposals is annexed.

Compendium of innovations based on this principle provides an opportunity to demonstrate the dynamism of activities of engineers in energy and power sector aimed at innovation, the theoretical and technical level of their thinking and its progress.

1.6

Batkhuyag S. (1997).

Scientific−methodological and practical problems of working out Mongolia's energy development strategy in socio−economic conditions.

Siberian Energy Institute.

Sc.D. thesis abstract, Mongolian

Key words: Energy sector, development strategy, fuel−energy supply.

On the basis of a comparative study of the situation prevailing in the energy sector with a development startegy, a methodology of policy planning and experiences of countries with market economy during the period of transition to market economy in the first half of the 1990′s, a question was posed: In what situation do we find ourselves? What is the reason of our being in this situation? What problems do the countries with market economy face in development of energy? What is the cause of it? What was the diffirence of methodologies of development strategy, policies and planning in market economies? etc. Methodologies worked out to answer these questions were used in studies aimed at elaborating policy directions to overcome a crisis and difficulties in energy sector and for its futher development. Theory and methodology as well as practical issues related

to development of Mongolia's energy and power sector were worked out to adapt to new socio−economic conditions.

1.7

Batkhuyag S. (2009).

Development strategy of energy sector: Theory and methodology, some practical issues.

KHUST publishing house, Ulaanbaatar, Mongolia.

Book, 362 pages, in Mongolian

Key words: Energy sector, energy industry

This book is compiled in a form of a summary of scientific research work, and includes a summary of the author's PhD and ScD dissertations and a monograph consisting of two works. It also papers reports delivered at research conferences, articles dealing with development of energy and power in Mongolia, several interviews in the central press and other publications.

The work is devoted to those who study Mongolia's energy sector, research workers and engineers interested in issues related to development of the sector and students of the Technical university.

1.8

Batkhuyag S., Enkhjargal Kh., Purevdorj G. (2007)

Past and present of Mongolia's energy sector, its short term development strategy.

Papers of the research conference on "Development of fuel, energy and power sector, its structure" (pages 47−61*)* Mongolia, Ulaanbaatar: "Monkhiin useg" Company Ltd.

Report, 15 pages, in Mongolian

Key words: Energy industry, development strategy

Report reviewed development of Mongolia's energy sector until 1990 in three stages and investigated and evaluated the present situation in the energy sector after 1990. It pointed out that in elaboration of Mongolia's

energy sector development strategy for coming 15−20 years, many factors such as the objective financial situation of today, feasibility, ways and means of actual participation in regional (North East Asia) economic cooperation, development trends of the energy sector in the world should be taken into account.

It put forward a number of proposals on how to elaborate and implement scientifically sound developement strategies and policies taking into account the objective financial and economic situation of the state and energy sector, and in conformity with trends of the world energy sector development.

1.9

Bayarbaatar Ts. (2009).

Programs and projects implemented in the energy sector.

"Energy & engineering" magazine, 2009−7(72) (Pages 32−38)
Mongolia, Ulaanbaatar

Article, 7 pages in Mongolian

Key words: Energy and power sector, project, program, investment, loan, assistance

The article presents the list and titles of programs and projects, describes their implementation in terms of duration, amount loans and banks that financed them, results achieved, along with tables showing the above indicators. It also reported about programs that have been realized after 1990 by heat plants with their own financial resources, works implemented in rural areas to use renewable energy respectively.

Foreign countries, international banking and financial institutions provided between 1990 to 2008 substantial loans and aid amounting to 575.3 million US dollars, of which 347.9 was loan, 227.4 million was grant aid. In total 67 programs and projects were implemented or are now in process of implementation on loans and grant aid. The article concluded that the government and the Line Ministry have paid great attention to investment in development of energy industry and energy generation. Loans were used for meeting immediate needs of building heat and power plants, its transmission, introducing technological reform and expansion of the delivery network, reducing energy loss, improving energy efficiency and achieved concrete results.

1.10

Bum—Auysh M. (2009).

Historical chronology of energy sector research and intellectual organizations' 50 years.

Mongolia, Ulaanbaatar

Book, 208 pages, Mongolian

Key words: Fuel, energy, mines, scientific research, blue prints

The book describes the history of birth and development of the scientific institute for project design and blue print, its contribution to reliable energy supply of the country. Project designers and engineers of the institute drew and realized most of the 35, 110, 220 kW transmission lines built in towns, settlements and rural areas of our country. The book relates about numerous works by researchers of energy sector on electrification of the country, defining the most optimal development strategy of energy and power system to work out the end—use balance of fuel and power, improve exploitation conditions of electric stations and heat energy network. The list of blueprint drawings and scientific research work done by the institute is annexed to the book.

1.11

Ganjuur R. (2007).

Study of modern management methods introduced in energy sector.

Compilation of reports and papers of a research conference devoted to the 85th anniversary of Mongolian fuel, energy and power sector on "Growth of fuel and energy sector"
(Pages 27—46) Mongolia, Ulaanbaatar: "Munkhiin Useg" press

Report, 20 pages, in Mongolian

Key words: Market, tariff, benchmarking, income from sale

It says that 14 different modern management methods and technigues were introduced in energy sector, namely the following: tariff design, benchmarking, rating, a single buyer model, a stop market, an auction market, Saifi—saidi—kaidi indexes, a vulnerable group tariff, a domestic

two part tariff, lighting tariff, monitoring loss in electric transmission and distribution, transparency and public participation. These methods were studied and results were appraised. In making transition to market relations energy producers implemented a single buyer model, stop market, auction market etc in stages and achieved concrete results. The study considered that in future, it is advisable to open and operate a market of energy suppliers and distrubutors in setting tariffs to eliminate subsidy between the two components—electricity and heat, and set tariffs for households on the basis of real expences.

1.12

Ganjuur R., Bekhbayar D. (2008).

Modern day energy managers.

Mongolia, Ulaanbaatar: "ADMON" press Private company ltd.

Book, 225 pages, in Mongolian

Key words: Energy sector, energy manager

It tells in an interesting and unpretentious yet unique manner about work and daily life of 17 managers, who are currently CEO's of energy enterprises and companies of Mongolia.

Work and life experience of these managers who are committed to progress of Mongolia's energy sector will be of special relevance and set an example to emulate to young engineers and technical staff of this sector.

1.13

Dansranjav P. (2008).

Mongolia's increasing energy consumption demand.

Institute of heat generation plants and ecology. Research works №10 (pages 36—58) Mongolia, Ulaanbaatar: "Bambi Foundation" press.

Article, 23 pages, in Mongolian

Key words: Energy consumption growth, energy balance, supply of elecricity, supply of heat

In this article the author gave a short appraisal of Mongolia's 2005 fuel, energy balance sheet. It describes shortly the basis of internal connection and interrelationship between electrification and economic development. The author also made calculations using MAED program to determine Mongolia's demand for electricity, heat energy and all kinds of fuels up to year 2050 and presented some of his findings.

Average consumption growth of energy and power during the peak hours between 2015 to 2020 will increase by 12.6 %, 12% between 2020—2025, demand for heat energy will increase nationwide 3.3 times between 2005—2025 and it is calculated that in 2025 the country's overall demand for fuels will reach about 12 million tons in terms of standardized fuel.

1.14

The World Bank (1995).

Mongolia energy sector review.

World bank, Washington, USA
http://www—wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1995/11/03/000009265_3961019144126/Rendered/PDF/multi_page.pdf

Study, 88 pages, in English

Key words: Energy supply, coal, electricity, heat, electricity distribution, cen—tralized heat supply, renewable energy, end users of energy

After the disintegration of the Soviet Union in 1990 Mongolian economy plunged into a deep crisis. In particular, the energy sector faced immense difficulties. Supplying Mongolia which is one of the coldest region of the world, with reliable electricity and heat was the most pressing issue and leaders of government and state began to receive foreign loans and aid to overcome the difficulties. As a result, supply of heat and electricity started to improve. This study focuses on achieving a reliable and safe functioning of the energy sector and making investment policy in energy sector more constructive and effective. Supply of coal, electricity, heat distribution to big towns, supply and distribution of heat and electricity, liquefied fuel to rural settlements as the most important part of energy supply was studied.

1.15

The World Bank (2002).

Energy Sector: Infrastructure Sector Profile

(pages 8—19) Mongolia, Ulaanbaatar

Chapter of book, 8 pages, in English

Key words: Coal, liquefied fuel, gas, energy reserve, sustainable development strategy of energy

The document presented by the World bank to the Investor's Forum of Mongolia reviews the current state of Mongolia's energy sector from the perspective of each energy reserve respectively, it contains a "Strategic plan of sustainable development of Mongolia's energy sector(2002—2010)" approved and being implemented by the Mongolian government. It also describes legal environment for foreign investment in energy sector, sub—sectors looking for investment, possibility of increasing private sector participation in energy sector development.

This is a study useful not only to the foreign investors, but to students interested in energy sector.

1.16

The World Bank (2001).

Mongolia — Energy efficiency in the electricity and district heating sectors

http://www—wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2002/02/09/000094946_02012604015017/Rendered/PDF/multi0page.pdf

Project document, 40 pages, in English

Key words: Electricity production, electricity transmission, electricity distribution, energy efficiency, heat production, centralized heat supply

The objective of the study was general review and appraisal of work accomplished by ESMAP from 1994—1998 to improve and renovate the electricity and heat supply system. A study was made to elaborate measures

to reduce loss in electricity, heat supply system of Ulaanbaatar and investment therein.

The study reached following three main conclusions: 1) Loss in transmission and distribution of electricity was 27% 1995, it increased to 30% in 2000, of which 14% was technical, 16% was non−technical loss. Transmission loss was greater at low voltage lines. 2) In heat system network great amount of water loss was the main problem. 3) It concluded that a combined study of electricity and heat loss was very important for implementation of cohesive measures in future.

1.17

James P. Rizer, Garry Vollans (2002).

Contributions to Mongolia's Sustainable Energy Strategy: 2003−2010.

Mongolia, Ulaanbaatar: ADMON Press http://pdf.usaid.gov/pdf_docs/PNADB440.pdf

Book, 384and 328 pages, Mongolian and English

Key words: Sustainable development, energy sector, energy market, energy saving, energy and power service

This book is written, in part or entirely, on the basis of reports outlining pressing problems by United States Agency for International Development during the period of elaboration Mongolia's energy sector policy. The first part of the book describes the Mongolian government policy of sustainable energy development strategy. The strategy is based on the following five principles: Financial stability; structural changes based on market economic system; providing energy service; Energy saving; Capacity building. Further it dwels on objectives to realize these principles, and the meaures to be implemented. This strategy defines general direction of development of the sector till 2010. The author pointed out that in this sense it stands out from other previous documents of the sector.

Its value lies in the fact that the book described current state of affairs in Mongolia's energy sector, appraised the difficulties it faces at this juncture of its development history and elaborated a strtegy that suits the present stage of development of the sector.

1.18

Zunduisuren Ch., Bayarsaikhan G., Enkhjargal Kh. (2009).

Theory and methodology of improving efficiency of energy and power planning.

Papers of the international research conference on "50 years of Mongolia's central heat supply system, future trends of its development", (pages 14−25) Mongolia, Ulaanbaatar: "Ungut hevlel" company Ltd.

Paper, 12 pages, in Mongolian

Key words: Planning, future prospect, electricity load, electricity consumption, heat load, heat consumption

Trends of growth of demand for electricity and heat (energy) in Mongolia was calculated to 2025 on the basis of a model specially created for the purpose. Consumption of electricity of new mines and industries to be built was estimated and added. Calculated according to these estimates demand on electricity system will be 902 GWh in 2015, 1160 GWh in 2020, 1500 GWh in 2025,Ulaanbaatar heat need in 2015 will be 1485 Gcalh, in 2025 1687 Gcalh. On the basis of consumption estimate the balance of production and consumption of years 2009−2015 was computed.

1.19

Zunduisuren Ch, Gantogoo Yo. (2002).

Energy Management,

Ulaanbaatar: "New Press" private company Ltd.

Book, 313 pages, in Mongolian

Key words: Energy management, investment project, planning, energy audit, price and tariffs, cost structure

The objective of authors were to help people to get a cohesive understanding of the concept of management at this juncture in time, when momentous changes and reforms are being carried out in energy sector, to assist and facilitate companies operating in energy sector to organize their activities in an appropriate way in the new environment of market economic

relations. It is divided in following chapters: Strategy and planning of energy, investment management; Manager's decision—making in energy sector, Energy market and marketing, Coordination of activities in energy sector, Project management in energy, Energy management in enterprises, Specific issues of energy management.

It is important because it viewed a wide range of energy management issues, such as energy design and blue print, supply, training, production and various aspects of consumption.

1.20

Zunduisuren Ch, Enkhjargal Kh., Tleikhan A., Enktor D., Amarzaya D. (2007).

Cause of lighting the hearth (Photo album and reference book).

Mongolia, Ulaanbaatar: "JKC printing" private company ltd.

Book, 330 pages, in Mongolian

Key words: Fuel and energy sector, construction, collective, historic develop—ment path of the sector

This book, devoted to 85th anniversary of the birth and rise of fuel and energy sector, contains photos and reference materials on chronology of development of the sector in its 9 chapters, including information on public (government) authorities, state—owned companies, other economic and business entities, training and research institutes, the top consumers of energy, public organizations, years of great construction, nature, people and energy, ecology. The chronology of the sector is divided into an initial period of energy sector, years of rapid development and construction, energy sector in transition period, photos of respective periods with relevant explanations. There are many photos that show specific nature of work of various organizations and collectives belonging to energy sector, diagrams and table.

This reference book and photo album are important tools to know about the development path of energy sector, organizations and work collectives working therein.

1.21

Intergovernmental Collaborative Mechanism on Energy Cooperation in North–East Asia (2006)

Energy policy and Statistics in Northeast Asia.

Republic of Korea, Energy economics institute

Book, 259 pages, in English

Key words: Energy cooperation in North East Asia, energy balance, energy reserve

In the framework of the Intergovernmental Collaborative Mechanism on Energy Cooperation in North – East Asia it describes current state of energy and policies pursued by Mongolia, PRC, Republic of Korea and Russian Federation respectively. It also presents each of these country's energy balance in tables in 1990, 1995, 2000, 2005.

A Comparative study of energy policies and energy balances in North East Asian countries is very important for developing an energy cooperation strategy for this region.

1.22

Intergovernmental Collaborative Mechanism on Energy Cooperation in North–East Asia (2007)

Country Report on energy outlook in Northeast Asia.

Republic of Korea, Energy economics institute

Book, 178 page, in English

Key words: North East Asia, future development of energy, energy demand of the region

In the framework of the Intergovernmental Collaborative Mechanism on Energy Cooperation in North – East Asia energy consumption of Mongolia, PRC, Republic of Korea, Russian Federation for the year of 2010, 2015, 2020 has been defined. The energy balance of these countries for 2004, 2010, 2015, 2020 has also been made in three alternative variants (ordinary, sustainable development and regional cooperaqtion variants).

Elaboration of various options of future energy development of North East Asia region is important for developing energy cooperation strategy of this region.

1.23

Landannorov J. (2007). UN Development program "Effective supply of energy to the society" MON/97/301:

Energy efficiency study of straw−bale and retrofitted buildings in Mongolia.

Mongolia, Ulaanbaatar: ADMON press

Study report, 67 pages, in Mongolian and English

Key words: Straw−bale, straw−bale building, retrofitted building, heat pro−viding coefficient, calculated heat load

Under the program "Effective energy supply to the society" in Ulaanbaatar, some schools and dormitories in rural soums, bagh service centers were built from straw−bale, a cheap material that reduces heat loss, and old buildings were retrofitted. This study report contains measurements to determine loss of heat in straw−bale and retro−fitted buildings. Heat loss in these buildings was compared to that of houses built from traditional materials as brick and wood, the objective of the study was by this comparison to demonstrate conservation of fuel, its positive impact on environment from a scientific point of view.

While it is possible to build a straw−bale house at relatively low cost using local materials, its heat loss is over two times less than in ordinary buildings.

1.24

National council for sustainable development (1999).

Modeling of energy planning.

Mongolia's sustainable development program for 21st century (pages 265−285) Mongolia, Ulaanbaatar: ADMON press

Book chapter, 21 pages, in Mongolian

Key words: energy consumption, energy and power system, energy consumption structure, an option of future trend, energy production and consumption, theoretic model of energy supply

Different options of Mongolia's energy development up to 2020 were reviewed and evaluated. They are: an option to preserve the current status

of energy sector and its development further, realization of conditions of energy conservation consistently, an option to pay more attention to renewable energy, preprocess coal before use, protection of nature and environment. Energy and main economic indicators of all these options were defined and compared with each other in tables and diagrams.

Mathematic models were used in assessing various options of Mongolia's energy sector future development and as such this is a study useful for researchers and decision– makers.

1.25

Purevdorj G. (2008).

Energy science.

Mongolia, Ulaanbaatar: "Sogoo Nuur" press

Book, 223 pages, in Mongolian

Key words: Science and technology, energy industry, renewable energy

The volume 103 of 108 volumes of "Science in Mongolia" series is a volume entitled "Energy Science". This volume represents a summary of historical development of Mongolia's energy sector, contribution of science, a role of collectives and scholars of research organizations in the sector's management and planning, past–present–future of energy technology and their inter–relationships, intellectual properties amassed in the sector.

This volume– a review of Mongolia's energy science and technological development containing a vast range of information – is an important work useful to those, who are interested in energy sector.

1.26

Sukhbaatar Ts.,Tumurbaatar Z., Batrenchin Sh., Tugsbayar S. (2007).

Present and future of energy sector.

Papers delivered on research and practical conference "Growth of energy and power sector and its construction" devoted to foundation of Mongolia's fuel and energy sector. (pages 7–16) Mongolia, Ulaanbaatar: "Monkhiin useg" press

Papers 10 pages, in Mongolian

Key words: Energy sector, coal sector, electricity supply, heat supply

The paper reviews and appraises a number of issues such as development tendencies in the world coal sector, Mongolian coal reserves, current status of production and consumption of energy, legal environment for growth of energy sector, current status of electricity and heat supply, its future growth, investment in energy sector, training of specialists, fuel and energy sector international cooperation.

The autor reached an important conclusion that it was essential to improve the sector's legal environment, upgrade electricity and heat supply and energy services through making the required investment, efficient production and consumption of energy, and increasing the sector's international cooperation. Realization of these measures will ensure reliable and unfettered growth of energy, the sector will not receive state subsidy, but contribute to the budget, it will no longer be an importer, but an exporter of energy. Achieving this objective will require uniting our efforts is the conclusion.

1.27

Tleikhan A. (2009).

Mongolia's development policy, pressing issues in energy sector and legal environment.

"Energy & engineering" magazine, June 2009(71) (pages 24－27)
Mongolia, Ulaanbaatar

Article 4 pages, in Mongolian

Key words: Development policy, mines, energy, integrated system of energy

The article raises following issues: mines and energy supply, energy and regional economic development, energy and social welfare policy, pressing issues in energy sector, ways and means of their solution, a need to make changes in energy law. It also dwells on how these problems could be solved. It concluded that in 5 years existing energy sources will not be able to meet evergrowing demand for electricity and heat supply that will result in energy shortage, therefore it was necessary to build immediately a new large energy source taking into account the needs of mineral deposits to be commissioned into operation. It pointed out that construction of a large electric power station will enable us to export electricity to PRC and

provide the capacity to compete at foreign market, it emphasized the need to occupy its place at energy markets of the North East Asian region. In addition, it also considers that improvement of legal regulations, creating favourable legal environment to attract foreign investment was needed. It will facilitate getting financial resources for construction of energy enterprises to satisfy the demand for energy and power. It expressed the view that the share of private sector in energy industry should be increased.

1.28

Thomas V. Smith (2003).

Tariff Methodology for the Energy Sector of Mongolia

World Bank, Washington, USA
http://pdf.usaid.gov/pdf_docs/PNADB456.pdf

Book, 208 pages, n English

Key words: Energy sector, structural changes, energy tariff, energy regulation, energy regulation office, special license

The Government of Mongolia requested USAID assistance for the energy sector's structural reform. Assistance was required in implementation of the newly adopted law aimed at commercialization of energy sector. One of the objectives of energy sector commercialization was reform of energy price and tariff. The main purpose of this study report was to provide Energy regulation agency with tariff methodology, because tariff plays a very important role in efficient regulation in energy sector. As the outcome of two years of study in cooperation with the Energy regulation office a tariff methodology suitable to the specific needs of energy production, transmission, holders of special licenses for distribution has been developed.

1.29

Tumentsogt Ts. (2007).

Mongolia Energy Strategy: Current Status and Programs

ERINA REPORT 2007, September Vol.77 (pages 13－20)
http://www.erina.or.jp/en/Research/db/pdf2007/07023.pdf

Article, 8 pages, in English

Key words: energy strategy, energy cooperation, North East Asia, sustainable development of energy

The article describes Mongolian policy of cooperation with countries of North East Asia in energy sector. In this research paper the author explained Mongolia's energy strategy, projects and programs being implemented as well as the present status of bilateral and multilateral cooperation in North East Asian countries, it put forward suggestions on effective cooperation in energy sector within the North East Asian region.

Revitalization of talks and meetings on North East Asian cooperation in energy sector, implementation of joint projects to study ways and means to improve exchange of information, capacity building projects realization in developing countries was essential as the article pointed out. It considered that there was the need for an organization of regional cooperation.

1.30

Frank Poo, Erdendalai L, The World Bank) (2007).

Commercialization of Super−Insulated Buildings in Mongolia − UNDP, GEF Project MON/99/G35. Final Independent Evaluation Report

http://mirror.undp.org/Mongolia/publications/Eval_Report_on_EEH_Feb%2707.pdf

Report, 39 pages, in English

Key words: Super−insulated private house, heating, heat loss, straw−bale, straw−bale building

The findings of an independent audit evaluation of the project on "Commercialization of Super − Insulated Buildings" is reflected in the report. The objective of the project was building as many as possible straw − bale buildings with less loss of heat and their introduction into housing market.

At the initial stage of project technical assistance in building heat − loss proof straw − bale was provided, training and advocacy programs, programs to build social service straw − bale houses such as schools, kindergartens, clinics, administrative buildings were implemented. Reducing heat loss in private houses was at the center of attention during the implementation of the project. As Mongolia's climate is very harsh, the heating season runs

for many months, most of the energy is spent on heating alone, therefore, it was concluded that providing public access to housing with reduced loss of heat was of utmost importance. There is a need to continue this study in order to improve heat insulation and conservation of ger. This is also viewed as a measure to reduce to some extent Ulaanbaatar air pollution.

1.31

Ministry of Justice and Internal Affairs, Ministry of Fuel and Energy (2007).

Law of Mongolia on Energy: Program on Integrated power energy system of Mongolia.

Mongolia, Ulaanbaatar:

Book, 64 pages, in Mongolian and English

Key words: Electricity production, electricity transmission, electricity distribution, heat production,heat transmission, heat distribution, special license, regulated supply of energy, unregulated supply of energy

Energy law adopted on 1 February, 2001, "Integrated energy and power system of Mongolia", a program approved by resolution No.10 of State Great Hural of Mongolia on 31 January, 2007 are published in a booklet in Mongolian and English languages.

1.32

Ministry of Justice and Internal Affairs, Ministry of Fuel, power and energy (2007).

Collection of legal acts related to functions of Fuel, energy and power sector.

Mongolia, Ulaanbaatar

Book, 424 pages, in Mongolian

Key words: Energy, renewable energy, energy system, electricity transmis—sion line, energy regulation, program of activities, Energy regulation agency, Council of regulators

In the first chapter 33 Mongolian laws are included fully or in part. In the second chapter 6 resolutions of State Great Hural of Mongolia are also included fully or partially. The third chapter contains 29 resolutions of the government. The fourth chapter contains 6 programs adopted by the State Great Hural and the Government of Mongolia. In chapter five it includes a resolution of the Supreme Court of Mongolia " On interpretation of some articles and clauses of energy law". The last sixth chapter contains a collection of resolutions adopted by the Council of regulators of the Energy Regulation Agency.

It provides an opportunity to access legal instruments related to fuel, energy and power sector from one source.

1.33

Khurelbaatar Ch. (2007).

Present and future of fuel and energy sector.

"Energy & engineering" magazine, 2007—10(55) (pages 8—11)
Mongolia, Ulaanbaatar

Statement, 4 pages, in Mongolian

Key words: Fuel, energy sector, coal reserve, clean technology of coal, elec—tricity supply, heat supply

This statement made at the meeting on the 85th anniversary of foundation of fuel and energy sector defines the current status of coal and energy sector of our country, pressing problems and goals for future growth. Importance of clean coal technology, in particular, production of liquefied fuel from coal was emphasized. The speaker pointed out the significance of improving the legal environment of energy sector, meeting needs of newly emerging large consumers— the mines in Govi region, finding investment, building a large power station on the coal deposit, so that we could export energy. He made a conclusion that by improving the sector's legal environement, by making the necessary investment, power and heat supply and service will be ameliorated. He concuded that we need to unify our efforts to deepen further international cooperation, which will enable us to produce and use energy efficiently, secure growth of energy sector to be self—sufficient and reliable. It will stop receiving subsidy from the state, but make its contributions to the state budget and will turn from an importer sector to an exporter of energy.

1.34

Tserenpurev T. (2007).

Innovation of information technology in energy sector. Management Academy.

Ph.D. thesis abstract, in Mongolian

Key words: Information system of management, information technology, innovation, national dispatch center, central energy system

The author researched development of Mongolia's management information system, theoretical problems related to introduction of innovation in management information system of the sector, utilization of progress of modern information technology in developing a variation of management information system and human resource capacity building. He defined emergence and growth of management information system, its structure and composition in energy sector of Mongolia and its development trend in the future. He divided development of management information system in stages and described its main functions of information systems. He elaborated a methodology to introduce in central energy system, an innovative management information system. He considered that the national dispatch center should be the focal point of management information system and it should oversee production of electricity and heat, transmission and prompt regulation of distribution, to supply energy according to production consumption, and to carry out servicing and monitoring.

1.35

Tsetsgee S (2007).

Planning and regulating economically sound energy production at the initial stage of market relations.

Collection of papers at research and practical conference "Growth of fuel and energy sector" (pages 85−96) Mongolia, Ulaanbaatar: "Munkhiin useg" press

Conference paper, 12 pages, in Mongolian

*Key words: Economically **efficient** planning of electricity production, economically sound coordination of dispatcher, relationship of coupled*

*production, **share** of standardized fuel spending, real price and cost of elec— tricity and heat.*

Under the quiestion of economic efficiency comes the whole process— interrelationships between economic subjects, interaction and influence on each other, the final outcome and they must be treated comprehensively. Today, when the entire society is making an irreversible transition to market relations, the most important thing is a capacity to evolve following these changes. At every moment, when the production cost is higher, it must be analysed and timely measures should be taken. This is a requirement we face. While examining issues of economic efficiency and energy production savings, one should treat the issue from the stand point of the system as a whole but not just a furnace or an individual turbine. The criteria, the object must be to keep the shifting cost at minimum. It was considered that an energy producer, taking into account seasonal differences in electricity and heat consumption, rise and fall in energy load should follow a condition that is the most suitable and optimal ratio for coupled production and it was the requirement.

This conference paper touches on vital and pressing issues in energy sector including how to improve efficiency of electricity production at central energy system, how to realize dispatcher's coordination, so that it will be economically sound, how to calculate real costs of electricity and heat.

1.36

Chimiddorj D.,Ganbaatar B. (2009).

Mongolia's state policy of fuel and energy.

"Energy & engineering" magazine, 2008—10(65) (page 18—22)
Mongolia, Ulaanbaatar

Paper, 5 pages, in Mongolian

Key words: Fuel and energy sector, strategic goal, priorities

The paper defines the strategic goals of the fuel and energy sector in a following way; " to secure economic growth of the country, its sustainable development and security, reliability of operations of fuel and energy sector, its safety is of paramount importance. It should be able to meet ever—increasing energy demand, efficient and economical, environment friendly technologies should be introduced into the sector, participation of

private sector should be encouraged, and the sector will build its capacity to export energy." To realize these strategic goals, it spelled out priority directions. They are: securing reliability and operational safety of the sector; increasing efficiency and crerating favourable conditions of work in market environment; processing of coal, introducing technology of clean coal; building capacity to export coal; increasing participation of private capital in the sector; human resource capacity building. A plan to be implented in these six prority areas was developed.

1.37

John Swartzbaugh, Amarsanaa S. (2006).

Public Education Strategy For Energy Sector Reform

http://pdf.usaid.gov/pdf_docs/PNACQ445.pdf

Project study report, 25 pages, in English

Key words: Public education, reform of energy sector, price and tariff, energy regulating agency

The objective of this study was to explain extensively to decision−makers, workers in energy sector, journalists and the public the significance of reforms in energy sector. Views of experienced specialists in this field were sought and analyzed and a conclusion was made that there was no sufficient understanding of energy reforms among general public and it was impossible to raise energy prices and tariffs suddenly.

It was considered that only after successful realization of a strategy to educate public on importance of reforms in energy sector people will understand and accept it, the reputation of energy regulatory agency will grow, its activities will be understood by the decision−makers and public alike and their relations and work connections will improve.

1.38

Erdenebat B. (2009).

Construction−foundation of growth (Fuel and energy policies and objectives)

"Energy & engineering" magazine, 2006−3(39) (pages 10−17)
Mongolia, Ulaanbaatar

Report, 8 pages, in Mongolian

Key words: Fuel and energy sector, development policy, energy and power system, energy supply

In this report delivered at the meeting of managers of Fuel and energy sector the speaker spelled out following goals to be achieved in this sector. One, to achieve self−sufficiency in meeting energy demand, reduce loss in system and make condition caliberation more productive, pursue the policy of lowering energy prodeuction cost; Two, in the light of regional development concept and in connection with plans to commission large mines in near future a number of policy measures to meet their energy demands will be developed and realized; Three,to improve fuel and energy sector legal environment, consistently implement a policy of creating favourable legal environment for business; Four, to make substantial steps to meet energy supply needs of small consumers in rural areas; Five, Fuel and energy sector will make significant contribution in reducing air pollution in Ulaanbaatar and other large cities; Six, a problem of meeting fuel demands of households in rural areas will be solved with the assistance of the state and the government; Seven, improve safety of operation of fuel and energy sector, build financial and capital potential of fuel and energy sector; Eight, solve energy sector privatization in a sensible and constructive manner.

1.39

Ministry of Mineral resources and energy, "Ulaanbaatar Heat network" state−owned shareholding company, School of Energy Engineering (2009).

50 years of Mongolia's centralized heat supply system, its future prospects and tendencies.

Mongolia, Ulaanbaatar: "Ongot khevlel" company ltd.

Book, 164 pages, in Mongolian

Key words: Centralized heat supply, heat network, heat generation power station, heat condition

This is a compilation of works of scholars and researchers, managers, engineers and technicians in last few years on reforms of heat supply system, its growth, ways of improving technical and economical efficiency and its utilization, improvement of its working conditions and renovation of

technology, introduction of new equipment and technologies. Programs and projects developed by them, as well as findings of experiments, outcomes of research and studies are included in this collection.

This work is intended for the use of researches and engineers in this field.

1.40

Energy regulating agency (2007).

Energy Statistical indexes−2008

Mongolia, Ulaanbaatar: "Munkhiin useg" press

Book, 70 pages, in Mongolian

Key words: Energy company, thermoelectric power station, coal mine, profit, loss, debt to collect, state budget, subsidy, fuel spending share, marketing income

The Booklet presents information on activities of large companies, business entities and organizations engaged in energy production and supply activities, this information is aggregated and shown in colour diagrams and tables. It shows financial and economic indicators such as profit, loss, debt to be collected, obligation to pay, tax paid, subsidies from state budget. Technical and economic indicators: electricity transmission, loss in distribuition, electricity and heat production of thermopower stations, distribution and exploitation of designed capacity, spending share of standardized fuel, price fluctuation of electricity and heat are also included in the study.

The Energy Regulatory Agency annually produces this booklet. Its objective is to make available information of large energy producing companies activities to state (public) organizations, researchers and general public. Its purpose is to collect and put in order ecomomic, financial, technical and several other indicators of several years to create a factual database.

2 Electric energy

2.1

Asian Development Bank (2009).

Demonstration Project for Improved Electricity Services to the Low Income Communities in Rural Areas

http://www.adb.org/Documents/GAR/MON/42534−MON−GAR.pdf

Project document, 37 pages, in English

Key words: Single− wire earth return electricity transmission system, electric supply in rural areas

As a result of implementation of this project living conditions of rural communities in bag will improve. Under this project electricity needs of rural communities will be met by single−wire earth return electric transmission system (SWER). Outcome of the project will be electricity supply for public services and private users in rural areas, it will also prove that single−wire transmission system is economical and it can be used for electricity supply in rural areas. The document describes in length activities envisaged under this project, a plan of action, the amount of money to be spent, outcome and information on peculiarities of single−wire earth return electric transmission system.

2.2

Asian Development Bank (2005).

Electricity Sectors in CAREC Countries. A Diagnostic Review of Regulatory Approaches and Challenges.

Manila, Philippines, ADB
http://www.adb.org/Documents/Studies/Electricity−CAREC/drrac.pdf

Book, 92 pages, in English

Key words: electric energy, energy regulation, electricity tariff

The objective of the Central Asian Regional Economic Cooperation(CAREC) program is to improve energy efficiency in the region , support activities aimed at economical usage of energy. This study attempts to justify a need for forum of energy regulators of CAREC member countries, describes difficulties and problems that energy regulators face. Chapter 8 speaks about Mongolia's energy production, transmission, distribution, electricity loss, energy production structure, responsibility and methods of work of energy regulating bodies, difficulties they face.

The study describes and compares energy regulatory environment and difficulties in regulation in each CAREC member country and in that sense it is a valuable study.

2.3

U.S. Agency for International Development (2002).

Commercialization Initiatives at Darkhan−Selenge Electric Distribution Network

World Bank, Washington, USA
http://pdf.usaid.gov/pdf_docs/PNADB470.pdf

Book, 71 pages, in English

Key words: Energy sector, electricity distribution network, structural reform, energy tariff, energy regulation, energy regulation agency, special license

As a result of reform in energy sector 18 energy companies were established. This report describes the process and outcome of commercialization of Darkhan−Selenge electricity distribution network. The report discussed at

length issues related to and measures to be implemented for a successful commercialization. It emphasized that in anticipation for commercialization following measures should be realized: improvement of management, accounting according to specific standards, reduction of technical and non−technical loss of electricity distribution line, improvement of debt collection rate, installation of new meters owned distribution network.

2.4

Arslan G. (2007).

Research and development of a method to improve precision of two−sided identification method for failure point in overhead /aerial/ transmission grid of 110 kW and higher. Moscow Institute of Energy

Ph.D. thesis abstract, in Russian

Key words: Aerial electricity transmission line, method of identification of a failure point, two−sided measurement, accident parameters

The author studied various factors affecting accuracy of the employed method to identify a failure point in overhead /aerial/ transmission line and determined how systemic element parameter errors influence the process. He calculated on case studies of Mongolia's energy system the allowed level of failure identification method inaccuracy and influence of allowed errors of systemic elements to develop a correlation curve between the two. He determined the level of systemic elements with support of accident time parameters, collected these outputs in a database and developed a new method of two−sided measurement to check using mathematic statistic means how much their deviation in meaning depended from the mean average of several years, how far that error will influence the precision of accuracy of identification of a failure point and their interrelationship. On the basis of this analysis he proved that it is possible to narrow down the precision of accuracy to ±3%.

2.5

Bat−Erdene B. (2005).

Developing a method for identification of a failure point on 110−220 kW overhead electricity transmission line. Moscow Institute Energy.

Ph.D. thesis abstract, in Russian

Key words: Overhead electricity transmission line, failure of the line, sensing coefficient

The author developed a new method of identification of a failure point. For fast and correct identification of a failure point he studied readings of electric parameters fixed during the accident and other means to identify the critical point in its complex. Along with assessing the upper and lower limits of sensing coefficients in core and reserve zones and a possibility to adjust and monitor the operational cascade, he collected readings of equipment with memory placed at various parts of the electric system and developed a new method to identify the failed part. He called this method a method of multiple points. The advantage of this method over the others is that before computing the failure point, equipment with error readings is determined and those readings excluded from further investigation, thus eliminating the possibility of errors in final stages of computing. This reduced errors previously used one or two−sided measurements by 3 points, which was proven through series of computing of multiple variants.

2.6

Gantogoo Yo. (2007).

Method of choosing an appropriate option of regional electricity supply (On example of Mongolia's Eastern region) University of Science and Technology.

Ph.D. thesis abstract, in Mongolian

Key words: Electricity supply, electricity consumption, non−linear mathematic imitation, non−linear mathematic model

The author developed a method to survey investment efficiency in energy supply and a model of energy balance between regional sectors. He proposed to prognosticate regional energy consumption subordinate from macro−economic indicators using a multidimensional linear regression, and also developed a non−linear mathematic imitation to cut off energy consumption and choose an appropriate structure of energy generator. The author made an assessment of current status of energy supply, worked out a method to define inter− sector balance, which reflects future

economic development of Mongolia's Eastern region as well as a method to prognosticate electricity supply subordinate from macro−economic indicators, tendencies of growth in electricity supply. On these premises he proceeded to develop different variants, where overall electricity supply production will cost lowest, up to 2003. Using a theory and methods of survey of regional development of electricity supply, he reflected in his study the peculiarities of regional economic development.

2.7

Gantumur Sh. (2005).

Developing methods, algorithms and mathematic models of computing fixed conditions of electricity.

University of Science and Technology.

Ph.D. thesis abstract, in Mongolian

Key words: Electric system, fixed condition, mathematic model, algorithm, linear model, non−linear model

The author compared and researched mathematic models of fixed regimes (conditions) of electric systems and worked out a general algorithm to be used jointly in computing at Fuel, energy and power stations of Mongolia, which is rather unique in its structure. To put this algorithm into operation a comprehensive computing program was developed in "VB−5.0" language, a Gauss method of computing of a linear model, a regression matrix method, a sub−matrix method, a triangulation method, an ordinary iteration method, a Zeidel method, a Z matrix method to compute a non−linear model, a Gauss−Zeidel method, Newton's first law (sequence I), Newton's second law (sequence II)and three different parameter methods were studied. The Newton's sequence II was chosen as being an equation closely satisfied by the method of diagonal relaxation. On this basis a complex program of regime (condition) computing Mongolia's electric system was developed, "Loss10" for network regime computing of 6/10 kV, "Gorim 1.0" for 35−110 kV network, "Gorim 2.0" for electric system of combined structure.

2.8

Douglas Bowman (2006).

Comments to the Generator's Two−Part Tariff Methodology

http://pdf.usaid.gov/pdf_docs/PNADN869.pdf

Project study report, 28 pages, in English

Key words: Capacity tariff, energy tariff, two part−tariff, special license for producing electricity

The project study report presents methodologies how set tariffs of special license holders for electricity capacity and tariff of electric energy on the basis of concrete examples. The purpose of these methodologies reside in improving electricity production, operational reliability, reducing overall expenditure of electric stations, encouraging initiatives of special licensees for production of electricity.

2.9

Douglas Bowman (2008).

Comments to the Generator's Two−Part Tariff Methodology.

Mongolia, Ulaanbaatar
http://www.eprc−chemonics.biz/documents/tech_reports/Proposed%20Tariff%20Reform%20Plan%20for%20Mongolia%27s%20CES_DBowman_Mon_27−May−08.pdf

Study report, 59 and 61page, in Mongolian and English

Key words: Tariff, cross− subsidy, energy market, livelihood level tariff, time−varying tariff

This is a study report prepared in the framework of the Economic policy reform and competitiveness project being implemented with assistance of USAID, which contains proposals and recommendations on tariff reform of central energy system and the plan of implementation. For tariff reform to succeed it was recommended to realize the following steps: a mean tariff for electricity consumers should be increased, so that energy companies can be financially independent, make transparent cross−subsidies between different classes of consumers, develop and introduce life line level tariffs

for vulnerable social groups, increase customer classes, decrease cross−subsidies of economic entities, make appropriate time−varied tariffs, capacity payment should be added for consumers of high voltage.

2.10

Douglas Bowman (2006).

Review of International experience with incentive regulation − for application in Mongolia's electricity transmission and distribution sectors

http://pdf.usaid.gov/pdf_docs/PNADN882.pdf

Project study report, 41 pages, in English

Key words: electricity transmission network, electricity distribution network, structural reform, commercialization, energy regulation

This report reviews and appraises international experience with incentive regulation of electricity transmission and distribution mechanism. It describes how these experiences could be applied in Mongolia's electricity distribution and transmission sector.

2.11

Douglas Bowman. (2008)

Proposed competitive power market design for Mongolia's Central Power System.

Mongolia, Ulaanbaatar
http://www.eprc−chemonics.biz/documents/tech_reports/Proposed_Market_Design_for_Mongolia%27s_CES_13−Nov−08.pdf

Study report, 62 and 68 pages in Mongolian and English

Key words: Single buyer, special licensee, model of electricity selling−buying market, system and market operator

It is believed that implementation of a general model of market proposed by the study prepared under Economic policy reform and competitiveness project being implemented with assistance of US AID will increase

competition, give incentive to energy companies to increase service prices and cost, support economically based dispatcher regulation, decrease expenditure of fuel and reduce air pollution. A number of changes and reforms are needed to realize this model. Namely, eliminating consumers' annual tariff, change a money flow regulation mechanism, electric energy companies, in particular, commercial relations between energy producing and distribution companies need improvement. It is envisaged that a plan to expand a national dispatch center will be developed on the basis of participating parties proposals of the sector for approval by Energy Regulatory Agency.

It is considered that this general model will serve as a basis for developing management and regulation documents such as Market rule, Integrated network rule, Mongolia's energy policy etc. It is also believed that the proposed general model of market will meet both the interests of participants in the electric energy sector and consumers.

2.12

The World Bank (2001.

Mongolia − Energy Project

http://web.worldbank.org/external/projects/main?menuPK=51521804&pagePK=51351007&piPK=64675967&theSitePK=40941&menuPK=64154159&searchMenuPK=51521788&theSitePK=40941&entityID=000094946_0104140845153&searchMenuPK=51521788&theSitePK=40941

Project document, 71 pages, in English

Key words: Energy sector, energy system, energy supply, electricity transmis−sion, electricity distribution, heat distribution, energy policy

The objective of this project is to reduce electricity loss, increase collection of electricity income and in this way to secure reliable operation and economic stability of electricity distribution companies. The study consists from following main parts: 1) to increase collection of income of the Ulaanbaatar electricity distribution company, assist electricity distribution system improvement in order to reduce technical loss to install new transformers, make investment in renewing low voltage transmission lines in order to reduce non−technical loss to install new electric meters in households of ger district. 2) to improve aimag electricity distribution system, install electric meters, renovate network of low voltage transmission

line, upgrade heat supply, install heat meters, to organize training of technical staff. 3) to organize training courses to enhance financial management of energy authority, improve its structure and composition, introduce best foreign experiences.

2.13

Jamyandorj P.(2003).

Research and perfection of a monitoring and measurement system of heat generation plants. Technical University, Technical University of Latvia

Ph.D. thesis abstract, in Russian

Key words: Heat station, normal regime, accident regime, measuring and monitor system, relay protection automatic instruments, micro—processor

In the course of his survey and through tests the author established that the system of continuous monitoring and adjustment of heat and power plants operation, in normal conditions and at time of accident, does no longer satisfy the needs of monitoring and control of modern industrial technological process and came forward with ideas of renovation. He proposed, in terms of software and programming as well as technically, a new solution, developed and introduced in production a micro—processor based system. "Aperiodic" or irregularity, which is one of the main causes of incapacitating of a metering system and reliability of automatic instruments of relay protection, he developed a new method placed on micro—processor of 16 bite to filter process.

2.14

Zagdkhorol B. (2004).

Optimization of Mongolia's energy system regime by its activated capacity. Moscow Energy Institute.

Ph.D. thesis abstract, in Russian

Key words: Energy system, system condition (regime), load, load distribution, real capacity, optimization

The author reviewed the load of Mongolia's energy system, its consumption volume and attempted to develop a simple, but highly effective method of optimal distribution of capacity between heat power stations. The researcher compared advantages and shortcomings of optimization of energy and power system according to a traditional and new methods, then studied a genetic algorithm and artificial neuron networks widely used in the world for optimization of energy system regime and their potential possibilities. On this basis the author developed a "cascade loading" method and an algorithm to optimize energy system with its real capacity. The computer program was written in Windows, using this method an optimization test of energy system regime was carried out in 3 nodes closed scheme, 15 nodes branching scheme, in various load cascade meanings (0.1 MWh, 0.5 MWh, 1 MWh) of central energy system with 41 nodes, the outcomes were analyzed, errors of the method were compared with manual and other optimization methods.

2.15

Lhagvasuren L. (2007).

Development stages of Mongolia's energy network, future trends.

Collection of papers of a research conference on "Development of fuel and energy sector" (pages 73—77) Mongolia, Ulaanbaatar: "Monkhiin useg" press

Report 5 pages, in Mongolian

Key words: electricity network, conductor cross section, economic density of current, techno—economic nomography

The report defines development stages of Mongolia's electricity network, theoretical methods used at different stages of development and pointed out that it will be advantageous to use further technico—economic nomography method. It was also stressed that there was a need to have norms and standards based on the technico—economic nomography method.

It concluded that use of technical and economical nomography for rehabilitation of electricity network, its expansion and new construction was more suitable in our country's environment and proposed that there is a need to develop norms and standards of elecricity network based on this method.

2.16

Nuurei B. (1996).

Methods and mathematic models of systematic analysis of development of emerging electric energy system.

Energy Institute of the Russian Academy of Sciences, Siberian branch.

Sc.D.thesis abstract, in Russian

Key words: Fuel, energy complex, energy system, systematic analysis method, mathematic model

The author proved from a scientific stand that energy systems of developing countries show the quality of large systems and defined it had space and time sequence. Namely, the time sequence was split into phases: short−term (1−5 years), project duration term (10−15 years), prognosis term (20−30 years) and it was established it can be researched with a systematic trend method. A systematic method of research of electric energy means studying that system in holistic approach in the framework of all sectors of the country and in close connection with fuel and energy complex of neighboring countries. It tested for the first time a non−linear mathematic imitation model of systematic research on the energy system of the Central region of Mongolia.

2.17

Onormaa Ts. (2007).

Investigation of mathematic models and methods for computing and analysis of fixed regimes of Mongolia's energy system. Energy Institute of Siberian branch of Russian Academy of Sciences.

Ph.D. thesis abstract, in Russian

Key words: Prompt dispatcher management, fixed regime, accident regime, after−accident regime(procedure), reliability of energy system, capacity bal−ance, electric circuit balance

The author studied the mathematical model of fixed regime and algorithms at every level of energy system, periodic and prompt (emergency) management and evaluation of regime optimization. She also surveyed

problems related to bringing the regime into the allowed region, analyzing and assessing accident regime, examining possible accident regime, evaluating reliability and sustainability of energy system. Alongwith Mongolia's energy nodes capacity balance model on rectangle coordinate and polar coordinate model, the author proved possibility of writing and using electric current balance on rectangular or polar coordinate system and studied non−linear nature of a fixed regime mathematic model in its complex.

2.18

Sodnomdorj D. (1995).

Developing a complex method of computing loss of Mongolia's electric energy network and measures to reduce it.

Siberian branch of Russian Academy of Sciences**.**

Sc.D. thesis abstract, in Russian

Key words: Electricity network, loss of electric energy

In his work on the basis of study of structural quality analysis of electricity network the author worked out a simple method of computing loss of electic energy at every level of capacity. He used a scheme of electricity distribution network and integrated indicators of regime and produced an equivalent model, a model of structure and balance, a linear and non−linear multidimentional regression model of electricity distributiion network respectively. On the basis of these models he developed a regime optimization algorithm, tests to chose the most beneficial structure of measures to reduce electricity distribution network loss, carried out their comparative study and developed comprehensive measures to reduce energy loss at 6−10 kW electricity distribution network.

2.19

Sodnomdorj D. (2007).

Current status of Mongolia's energy, future trends.

Collection of papers of research conference on "Development of fuel and energy sector" (pages102−118) Mongolia, Ulaanbaatar: "Monkhiin useg" press

Report, 18 pages, in Mongolian

Key words: Energy complex, security, price and tariff, optimal meaning, future trend, renewable energy, privatization, investment activities, micro—system, structure, atomic powerr station

The speaker appraised the current status of Mongfolia's energy, and discussed many pressing issues such as achieving energy security, establishing optimal meaning price, defining future constructive development of fuel energy complex, privatization of energy sector objects, defining efficiency of investment activities, energy conversation policy, development of renewable energy.

He made extensive research and conclusions on the current status of Mongolia's energy and power, discussed an energy micro system and its structure and proposed to build a small atomic power station.

2.20

Sodnomdorj D. (2009).

On improvement of technical and economic efficiency of capital city electricity network.

Collection of papers of a research conference on "Capital city development — science and technology" (pages 103—109) Mongolia, Ulaanbaatar: "Monkhiin useg group" ltd.

Paper, 7 pages, in Mongolian

Key words: Electricity network, energy loss, technical loss, marketing loss

The speaker describes measures to reduce energy loss in capital city distribution network, which is the main technical and economic indicator, and discussed outcomes of studies and project works in this field. One of the major energy conservation problems is loss of energy. The speaker concluded that it was greatly important to identify this problem and implement a complex of technical and organizational measures to reduce loss and calculate its technical and economic benefits.

2.21

Sergelen B. (2000).

Electric drive with two synchronous motors supplied from one current type frequency converter.

Prague, Czech Technical University.

Summary of Doctor's (Ph.D.) thesis, in English

Key words: Synchronous motor, speed regulator, electric transmission, frequency converter

The author carried out research studies to lower cost and expenditure of high power synchronous motors and sought to resolve difficult technical problems connected with electric transmission of running two or more motors from one current type frequency converter. Synchronous motors were fed by three phase load generator using "MATLAB" program. It was running from synchronous to stable load and its readings were defined. While it was established that during ignition two synchronous motors could work in normal regime, they were supplied from one current type frequency converter and mathematic models of controlling them by frequency cycle, current cycle frequency were worked out. One current type frequency converter now used in energy, mines, economy, light and heavy industry may be used to run two synchronous motors, thus cutting down the number of converters, decreasing electric transmission cost. Savings made open a possibility to increase economic effectiveness.

2.22

Khand–Ish Jh. (1998).

Increasing reliability and effectiveness of continuous operation of Mongolia's Central energy system.

Ural Technical University

Ph.D. thesis abstract, in Russian

Key words: Accident regime, accident resistant automatic device, transmis–sion network, reliable operation

The author carried out a study on securing continuous and reliable operation of the Central Energy System at time of lack of information on accident regime, and developed a model to optimize working of conditions and make a choice of centralized accident resistant automatic devices. The researcher studied technical management in accident situation and developed an algorithm model of accident resistant automatic system management, defined cross section dangerous volume of transmission, network, which could lead to the system stoppage, defined the capacity flow, which could lead to this dangerous volume. The researcher also developed mathematic models of multi−dimensional scheme of Mongolia's fuel, energy system, ways to secure reliable and continuous operation of an energy system during operational regime changes. The author also developed mathematic models to evaluate given system's operation and modelled the functions of accident resistant automatic devices, thus created conditions for optimal technical management during time−constraint or when there is lack of sufficient initial information on accident.

2.23

Khuyagdorj M. (2005).

Mathematic models of Mongolia's energy resources and their consumption.

University of Science and Technology.

Ph.D. thesis abstract, in Mongolian

Key words: Energy resources, consumption, economic−mathematical macro−model, statistic model, dynamic model, electric energy system

The author developed Mongolia's demand for energy sources, mathematical models for identification of electricity and heat demand in relation with macro−economic indicators of aimags, which have not been connected to the (Central) energy system. In developing these mathematic models system research methods were used. On the basis of these models the researcher worked out future consumption planning of energy system.

3 Heat energy

3.1

Asian Development Bank (2008).

Project Completion Report Ulaanbaatar Heat Efficiency Project:

http://www.adb.org/Documents/PCRs/MON/29629−MON−PCR.pdf

Project document, 42 pages, in English

Key words: Heat supply, heat efficiency

In this project completion report outputs and works carried out under the project to improve the efficiency and reliability of the heat supply in Ulaanbaatar implemented on 40 million US dollar loan from Asian Development Bank are described at length. Under this project a number of work such as transfer of heat network to an adjustable regime, end−use heat control, installation of measuring devices, improvement of a steam production system and heat network management and exploitation were realized.

As a result of implementation of this project heat network pumps were transferred to an adjustable regime and between 2000−2005 electricity consumption of the third power station was reduced by 49 %, and 20. 5% increase in heat supply was achieved. The same result was achieved at the fourth power station. Electricity consumption for distribution of heat unit, which was 21−10 kWh/Gcal, was reduced to 12−9 kWh.

3.2

Asian Development Bank (2007).

Community−Based Heating Supply in Rural Remote Areas

http://www.adb.org/Documents/GAR/MON/40277−MON−GAR.pdf

Project document, 35 pages, in English

Key words: Heating furnace, carbon−dioxide, coal

It was thought that as a result of implementation of this project heat supply would improve in soum centers and stabilization of heat supply service would lead to lesser coal use and reduce emission of carbon dioxide. An integrated system of exploitation and servicing will be established under this project.

As a result of implementation of the project there will be up to 40 % saving of local expenditure for purchase of coal, carbon dioxide emission will be reduced up to 40 % as well, heat supply, maintenance and service, debt and accounting system of 12 soums will improved, 25 energy−effective furnaces will be installed.

3.3

Altangerel T., Dorjpalam. (2009).

A need to reduce apartment building heat loss, its benefits.

Collection of papers delivered at an international research conference "50 years of Mongolia's Centralized Heat Supply System, Future Trends" (pages 61−69) Mongolia, Ulaanbaatar: "Ongot Khevlel" publishing

Paper, 9 pages, in Mongolian

Key words: Heat transmission, heat loss, loss through insulation, loss through air penetration

Though the main cause of insufficient heat in apartment buildings is connected with a heat supply network, the authors considered that in most cases it is because of far higher than allowed level heat loss in those buildings. Therefore, they emphasized that it was important to determine more thoroughly heat loss in apartment buildings and retrofit them and compute economic foundation of heat energy conservation and realize it in pracice. Retrofitting 20 buildings belonging to one hopsuing office will require 400−800 million togrog and it was calculated that heat supply seasonal costs will be reduced by 15000 Gcal or 90 million togrog.

3.4

U.S. Agency for International Development (2004).

Preliminary Market Assessment for Heat−Only Boilers in Mongolia

NEXANT, Washington, USDA
http://pdf.usaid.gov/pdf_docs/PNADC231.pdf

Project study report, 50 pages, in English

Key words: Heat furnace, burning efficiency, combined production of elec−tricity and heat

The author studied the present status of Mongolia's heat furnace market, and to overcome difficulties in heat furnaces and successful operation in present market, proposed that the following measures should be implemented. They are: to get financial resources for heat furnace improvement project; to reduce coal transportation cost; in order to increase burning efficiency of heat furnaces to preprocess the coal at coal mines by washing, cleaning and separation; to increase unit capacity of heat furnaces; to carry out studies on use of heat pumps and renewable energy and develop technical and economical evaluation; where there is a heat furnace and diesel fuel, to undertake research on converting heat supply into combined electricity and heat production.

3.5

Ministry of Nature, Environment and Tourism. Development and realization of capacity building of carbon financing projects (2009).

Market Survey of Heat−only Boilers and Coal−fired Water Heaters.

Mongolia, Ulaanbaatar: "Toonot printing" Itd.

Book, 51 pages, in Mongolian

Key words: Water heaters, heat supply system, heat network, furnace, smoke gas, coal expenditure, air pollution, heat furnace standards

The objective of the study was inventory of water heating furnaces in six districts of Ulaanbaatar, determine the fuel demand of these furnaces, assess the volume of poisonous emissions in air, work out recommendations on measures to improve operation of water heating furnaces, and their

replacement. The study covered relatively high−capacity 89 furnaces supplying heat to schools, kindergartens, public organizations and several other objects, 1005 small independent coal−fired water heater furnaces belonging to small service facilities in suburbs of the city.

The study has become a very important work for working out, planning and implementation of measures to improve heat furnaces in Ulaanbaatar, identify impact of water heating furnaces on air pollution and reducing air pollution in Ulaanbaatar.

3.6

Byamba−Ochir D. (2009).

Inception and development of Mongolia's centralized heat supply.

Collection of papers delivered at an international research conference "50 years of Mongolia's centralized heat supply system, future trends", (pages 5−10) Mongolia, Ulaanbaatar: "Ongot khevlel" press ltd.

Paper, 6 pages, in Mongolian

Key words: Centralized heat supply system, heat transmission, heat network

The author reviewed history of inception and growth of a centralized heat supply system in Mongolia in 4 phases: The early stage of inception and development of a centralized heat supply system (1959−1969); the second phase of radical changes in expansion of network, automatization of a consumer system(1969−1983); the third phase of rapid capacity−building of heat production, eradication of a huge gap between supply and demand, heat production and consumption through decisive intervention(1984−1990); time of reform and changes in heat supply and distributiion network after successfully coming through a difficult period of economic and political transition and started the new beginning (from 1990 untill today). Centralized heat supply, on the one hand, is a reliable source of heat and electricity, on the other hand, it experiences a pressure of increasing consumer demand, so working under the pressure and limits of these two factors is the pecularity of its operation. The author concluded that government in the framework of an integrated energy development policy takes into consideration the above pecularity, interdependence between producer and consumer as well as what is binding them and secure balanced development and appropriate interrelationship of these three. The researcher concluded that to this end the government is required to implement successive policy measures.

3.7

Byamba–Ochir D. (1999).

Research and elaboration of ways to increase centralized heat supply system effectiveness in regions with harsh continental climate.

Technical University.

Ph.D. thesis abstract, in Mongolian

Key words: Centralized heat supply, heat transmission, heat network hydraulic regime, heat loss, heat distribution sub–station

The author made a comparative study of optimal technical and technological solutions of centralized heat supply improvement of cities situated in harsh climatic conditions on the example of Ulaanbaatar, on ways to conserve energy, improve caliberation of a heat system and find technological solution to these problems. The researcher on the basis of a heat transmission theory, the nature of liquids and using equations on hydrodynamics by theory on the chain of liquids elaborated a mathematic model of heating system. He used this model to evaluate a hydraulic regime of a heat network, identify heat network loss, assess functions of heat sub–stations, heat loss of buildings. He defined ways and means to increase efficiency of investment in a heat supply system, determined and evaluated loss in a heat supply system by the outside temperature, wind speed and ways to reduce the loss and developed principles of increasing Ulaanbaatar centralized heat supply sytem efficiency, build heat distribution sub–stations of the network, transferring the network to quantitative and qualitative adjustment.

3.8

Ganbaatar B., Boldsaikhan S., Ganzorig B. (2008).

Converting BKZ–75–FB furnace at a boiling layer to fuel burning technology project, its outputs and significance.

Energy sector scientific research works. (pages 98–108) Mongolia, Ulaanbaatar: "Bishrelt Tenger" publishing

Article, 11 page, in Mongolian

Key words: Heat power station, boiling layer, solid fuel burning technology, nitric oxide, air distributor

To meet growing demand for energy there is a need to improve traditional methods of energy production based on burning organic fuel, to reduce air pollution as far as possible. For tackling this immediate and emerging task we have to pay special attention to development of a clean technology to supply energy producers, to use traditional reserves properly, efficient consumption and conservation of energy in production, transmission. In foreign countries a boiling layer burning regime is widely used in a technological process of energy production. For the last several years experiments and research to burn solid fuel in a low temperature boiling layer composed of various inert materials like ash and additives to absorb sulfur have been widely caried out and being introduced in practicve. This study describes outputs of the project how a BKZ−75−FB furnace was converted to burning fuel in a boiling layer technology.

When a BKZ−75−FB furnace was converted into a technology of burning fuel in a boiling layer, its negative influence on nature and environment was reduced, conditions of labor improved, operational expenditures decreased.

3.9

German technical cooperation association (2009).

Legal handbook on exploitation of heat furnace.

EU−ASIA PRO II PROGRAM, European Union. Community−Based Heating Supply in Rural Remote Areas project. Mongolia, Ulaanbaatar: SOFECT publishing.

Book, 296 pages, in Mongolian

Key words: Heat furnace, heat supply standard, technical requirement, smoke composition, heat pipes

The book is a compilation of standards, rules and instructions in force in Mongolia as reference to economic entities operating heat furnaces and supplying consumers with heat, for those, who want to build such furnace for official use according to the Energy law.

A careful study of operational instructions of furnaces, strict observation of technical exploitation will ensure reliable functioning of furnace, its effectiveness will increase and operation and maintenance expenses will dectease and conditions to supply consumers with quality heat will be met.

3.10

Davaasambu Ch. (2001).

Experimental study of low capacity heat generator.

Energy Institute of MUST

Ph.D. thesis abstract, in Mongolian

Key words: Heat supply system, low capacity heat generator, heat exchange, fire sphere, efficiency coefficient, heat exchange multiplier

The author carried out tests and studied heat technical indicators of private houses, methods of heating, a heat supply scheme, assesed the given time status of a heat source and produced a physical model of heat exchange in a fire sphere of low capacity heat source, designed equipment and carried out experiments to identify an optimal volume fire sphere that will burn solid fuel, developed mathematic method and studied by tests heat exchange of a fire sphere. He also studied influence of generator's heat exchange intensification on geometry of a fire sphere and its regime indicator. He studied posibility of using heat pipes to increase efficiency of small capacity generators and reduce emision of poisonous substances. After determining an optimal volume of a fire sphere and intensification of heat exchange in it there was 0,4−0,75 increase of an efficiency coefficient and when the content of small coal particles increased in a stagnant layer by 10−50% aggregated heat exchange in a fire sphere decreased 2−3 times.

3.11

Jargalkhuu L.(2005).

Study of highly effective heat generation plants for Mongolia's heat power station.

Technical University of Ural

Ph.D. thesis abstract, in Russian

Key words: Solid fuel, gasification of solid fuel, furnace efficiency coefficient multiplier, heat generator

The author gasified local solid fuel for use in a generator and carried out experiments and tests on internal combustion microheat and power center

and proved that it was possible to use it our country. It was ecollogically clean and an efficiency coefficient multiplier of the furnace was relatively high. In order to increase efficiency of a heat generator, various heat exchange devices with whirlwind effect were installed in a gas generator. With that heat mass exchange a test was conducted at laboratory equipment and the output was processed using STATGRAPHICS for WINDOWS program. As a result of the study it was corroborated that supply of energy demand of distant soums and settlements of our country could be met by operating such heat generators.

3.12

Yondongombo G.(1999).

Technology of furnace ignition by fuel plasma burst not with heavy oil.

(On example of a trail test at BKZ−420−140−10C boiler Ulaanbaatar HPS−4). Eastern Siberian Technological University of Ulan−Ude

Ph.D. thesis abstract, in Russian

Key words: Heat and power station (plant),mazut (heavy oil), ignition of furnace, ratio of coal and air, fuel plasma burning

The author studied ignition of boilers at heat and power stations working on coal dust and worked out a theory and computing principles of igniting Baganuur coal by plasma burst without heavy oil. Thermodynamic process computing of Electro−thermo−chemical preprocessing of coal was made on ASTRA−4 program and coal−air optimal ratio was determined, also technical and economical principles of the BKZ−420−140−10C ignition boiler at Ulaanbaatar Heat and Power Station 4 by plasma burst without heavy oil and its efficiency were computed by the same author. He reviewed schemes of plasma burst system, kits principle elements and plasma generators in general and carried out production and laboratory experiment tests to ignite the BKZ−420−140−10C boiler in warm and cold status without using heavy oil. The author on the basis of these tests developed a technology of igniting boilers by plasma bursts without using heavy oil on example of the BKZ−420−140−10C boiler at Ulaanbaatar Heat and Power Station 4.

3.13

Namhainyam B.(2008).

Urgent development issues of heat supply in urban areas of Mongolia.

Academic works of the heating energy sector (pp 9—20), Ulaanbaatar, Mongolia: "Bishrelt tenger" Printing House

Article, 12 pages, Mongolian

Keywords: heating, average capacity heating systems, low capacity hydrothermal stoves

The heat supply systems operating in Mongolia at present are classified by their capacity, coverage, level of effectiveness into three groups (heating systems of Ulaanbaatar, Darhan, Erdenet, Choibalsan: centralised heat supply systems at aimag centres and satellite towns: low capacity heat supply systems) and the present situation of heat supply, its pressing problems are described by each category. A list of measures to be taken further in order to improve the heating systems, drawn up by the author, is important as recommendations to engineers and technical workers.

3.14

Namhainyam B., Amarbat L. (2009).

Demand for thermal energy in Ulaanbaatar and ways to meet it.

A compilation of papers at the international research conference on "The 50th anniversary of the centralized heating supply system development in Mongolia and its future trends" (pp 34—45), Ulaanbaatar, Mongolia: "Ungut hevlel" LLC

Paper, 12 pages, Mongolian

Keywords: thermal generator, centralized heat supply, capacity balance, heat duty, hydrothermal stove, home stove

Such issues as heat duty of Ulaanbaatar city, growth of demand until 2020, capacity reserves of thermal generators in the city, linking expansion of the city heating network with location and duty of new districts to be constructed in the future, selection of location, capacity and types of new generators are examined in the paper. Sustainable implementation of the

thermal energy conservation policy is emphasized. For instance, the author views that the heat duty might be reduced by 30 — 40 percent, if the norms and standards of heat loss in walled — in design in buildings construction is followed strictly. Furthermore, steadfast introduction of heat meters usage by business entities as well as in public housing, bringing the heating price system into conformity with the market principles are highlighted in the paper.

3.15

Namhainyam B. (2007).

On the issue of improving the structure of generators at Heat and Power Stations and increasing efficiency of heating systems.

A compilation of papers at the research conference on "Development of Mongolian fuel and energy sector" dedicated to the 85th anniversary of the Mongolian fuel and energy sector, (pp 124 — 132), Ulaanbaatar, Mongolia: "Munhiin useg" LLC

Paper, 9 pages, Mongolian

Keywords: HPS, individual fuel spending, heating network, the network water consumption, heating

The main direction of energy development in Mongolia is heating and a fact that heat and power stations account for 95 — 97 percent of total national power production is the proof of it. Heating has a special advantage as it gives an opportunity to produce 1 kWtt energy with little fuel, for instance, with 160 grams of example fuel. At present heating systems of Ulaanbaatar, Darhan, Choibalsan and Erdenet cities are operating to produce electric power as well as to supply these cities with heat. The paper analyzes heating problems in following three directions: improvement of the structure of generators at power stations as the main method of increasing profitability of the energy sector; introduction of new technologies and equipment as the main condition of proper use of thermal energy; increasing effectiveness of the energy sector as an economic as well as an environmental issue.

In order to increase effectiveness of the energy sector reccommendations are made to reduce individual fuel consumption of power production at power stations, to increase economic efficiency of projects implemented with loans and assistance, to improve the regime of the heating network.

3.16

Suhbaatar U.(1996).

Study of the abrasive deterioration process of furnace equipment and development of protection methods

The Siberian branch of the Russian Thermal Technical Institute /Sib.RTI/

PhD thesis abstract, Russian

Keywords: heat and power station, abrasive deterioration, coal characteristics

The author studied deterioration of coal dust preparation and transmission equipment of the furnace at the heat and power station, resulting in explosions, and determined that it is "abrasive deterioration" related to the Baganuur coal characteristics. Tests to develop new ceramic materials with protection against deterioration were conducted and produced materials were introduced in production. Further, the coal dust flow pattern was studied, a new meaning of the coefficient of uneven distribution of its speed and concentration in different locations of shapes of pipes and equipment was calculated. A conclusion was made that deterioration of the given equipment depends on the form, shape, size of its surface and its location. Methods were developed and solutions were suggested to change the speed, uneven distribution of concentration, the angle and direction of small erosive particles, when they hit the surface and to reduce their impact. A technology of production of wear−resistant ceramic materials with local raw materials was developed and several kinds of ceramic materials were produced. A method of protecting the BKZ−75−39 and BKZ−420−140 furnace equipment from abrasive deterioration was developed and implemented in practice.

3.17

Hishigsaihan D. (2006).

Hydrodynamics and internal heat exchange of twisted streams formed by multichannel axial swirlers of furnace burners.

Ural Technical University

PhD thesis abstract, Russian

Keywords: furnace burner, heat exchange, burning process

The author studied pressure and temperature of twisted streams of furnace burners, developed a model of the stream structure and examined changes in size and forms of stream components depending on the swirler design, its geometrical characteristics and the work conditions. He determined a correlation between the stream physics and design parameters, developed a methodology of calculating "combined structure and conditions parameters" of twisted streams, and calculated a correlation between an acoustic wave created under influence of coherent structures in the twisted stream and internal heat exchange intensity. As a result of comprehensive research, tests on heat exchange, hydrodynamics and acoustics the author gave reccommendations on making of burners of swirling design. He developed ways to burn fuel completely and reduce poisonous substances emitted during burning by determining parameters of fuel and oxidants streams mix, intensification of swirling, selecting proper conditions, managing the burning process in burners.

3.18

Hurlee D., Nyamdeleg Ch. (2007).

The present condition of the centralized heating supply in Erdenet, and urgent problems faced in its further renovation and development.

A compilation of papers at the research conference on "Development of Mongolian fuel and energy sector" dedicated to the 85th anniversary of the Mongolian fuel and energy sector, (pp 133−140), Ulaanbaatar, Mongolia: "Munhiin useg" LLC

Paper, 8 pages, Mongolian

Keywords: Heating supply, loss, insulation, heating

The heating supply system is an important indivisible part of the energy sector. It is a large surface and underground engineering entity, which consists of main and secondary pipes to distribute thermal energy produced by heat and power stations to consumers in the form of steam and hot water, distribution facilities, a set of equipment for consumers to access heating. In the course of centralized heating supply development since 1959 up to the present time, in 47 years, numerous works to improve technical and economic outputs of heating transmission were planned and implemented and certain progress is achieved. The present condition of heating supply system of Erdenet as a component of the centralized heating system as well

as technical and economic indicators of the power station were studied and analyzed. Such pressing problems as introduction of new techologies and equipment at the Erdenet heat and power station, improvement of heat distribution and sales, development and implementation of economy are addressed in the paper.

4 Renewable energy

4.1

Asian Development Bank (2002).

Renewable energy development in Small towns and Rural areas in Mongolia

http://www.adb.org/Documents/TARs/MON/tar_mon36255.pdf

Project document, 12 pages, English

Keywords: rural power supply, renewable energy

The document shows studies and justification of the project implemented with ADB assistance to develop a renewable energy strategy for isolated rural areas, to study hybrid pilot systems that may complement existing diesel generation in schools and hospitals, and analyze options for mainstreaming renewable energy to improve access for nomadic families.

4.2

Asian Development Bank (2005).

Hydrothermal Heat Supply of Province Center

http://www.adb.org/Clean−Energy/documents/MON−PFS−Geothermal−Energy.pdf

Study report, 31 pages, English

Keywords: natural geothermal resources, centralized heat supply

This study examined a possibility of a geothermal district heating system in the province center around the Khangai Range and outline the pre−feasibility study based on reports on the geothermal energy resources in Mongolia and international experiences on utilization of the hydrothermal energy. Section 1 of this report covers the present heating system in the province center in the region of Khangai range and the experience of utilization of geothermal energy in other countries of the world.

Section 2 outlines the operation costs of the coal−fired boilers of the province center, the existing heat demand of the province center, the trends of future heat demand growth, the scheme of main units of a geothermal district heating system. It is calculated that investment of approximately 13.3 US dollars is necessary for a geothermal aimag heating system in Hangai region.

4.3

Asian Development Bank (2006).

Wind Energy Supply for Off−grid Small Town

http://www.adb.org/Clean−Energy/documents/MON−PFS−Wind−Diesel−Hybrid.pdf

Study report, 31 pages, English

Keywords: renewable energy, wind energy, wind power station, wind resources, wind speed

This report presents the results of a pre−feasibility study of a small−scale wind power station construction at a soum center in Govi regions in Mongolia. A study was carried out to replace the current costly diesel generator in the soum centre by a new, ecological energy source − wind power station. The report considers the issues that may arise in planning for, installing and operating a small−scale wind turbine near the soum center. Results of wind resources measurement in local area were compared to the quantitative indicators of the Mongolian wind resources atlas.

The methodology used in the study can be used for development of justification and calculations for construction of a wind power station in other soums with rich wind resources and for other research.

4.4

Ganhuyag D., Purevdagva N., Ligden M. (2008).

Results of study on establishment of the wind park, its feasibility, obstacles faced.

Papers of a National forum on Renewable energy (pp 47−50) Ulaanbaatar, Mongolia.

Paper, 4 pages, Mongolian

Keywords: Wind park, daily conditions of wind speed

The paper presents feasibility study results of establishing a Wind park of 50 MW capacity with use of 2 MW Wind Power turbine depending on wind resource specifics of the Shar Huviin mountain range and the Salhit mountain. A conclusion was made that a need arose to reform a power supply system structure in the Central region of of our country by establishing a new Wind park, which produces power in an environmentally friendly way, reducing greenhouse gases and saving clean water and coal. Problems in transportation of heavy, large−size components of the 2 MWt capacity Wind Power turbine from Zamiin Uud to Choir on a vehicle of a special design, transportation of a heavy−duty crane needed for assembly of the WPT were mentioned specifically. Authors also view that some ambiguous articles in the Law on Renewable energy and the Law on Energy obstruct development and implementation of an Agreement on purchase and sale of electric power at international level and restrict legal environment for real investment in this field.

4.5

Ganchimeg M., Battushig G., Ulambadrah B., Bayarhuu E. (2007).

On the issue of coordination of prices and tariffs on renewable energy.

A compilation of papers at the research conference on "Development of Mongolian fuel and energy sector" (pp 273−286), Ulaanbaatar, Mongolia: "Munhiin useg" LLC

Paper, 14 pages, Mongolian

Keywords: renewable energy, prices and tariffs of renewable energy, wind park, hydropower station, solar power station

The paper mentions a need to create a favorable legal, investment and tariff environment in order to develop renewable energy and summarizes experience of coordinating prices and tariffs for renewable energy followed in European countries with highly developed renewable energy sources. Authors made suggestions on determining prices and tariffs for power produced by Taishir and Durgunii hydropower stations that are starting operations at present and the planned Wind park of 50 MWt capacity. When a cost analysis of the investment project on construction of a renewable energy source was made at Taishir and Durgun hydropower stations, implementation of these projects at present prices and tariffs was not economically beneficial. A conclusion was made that an opportunity to implement these projects in a profitable way was possible only if the power prices were at the highest level stipulated by the Law on Renewable energy.

4.6

Davaasuren Ch., Baatarhuu M. (2008).

Establishment of a large−scale wind park in Shiveegovi soum of Govisumber aimag.

Papers of a National forum on Renewable energy (pp 87−94) Ulaanbaatar, Mongolia.

Paper, 8 pages, Mongolian

Keywords: wind energy, wind resources, wind speed, wind speed direction

Utilization of wind energy is very efficient for the economy of the country and is environmentally friendly, so developed countries avoid using organic fuel in energy production and started looking for environmentally friendly sources. In order to use wind energy in electrification of the country an issue of studying wind resources is of great importance. The paper presents results of the study on determining regional wind energy resources with use of wind data at altitude of 20 and 30 meters from the automatic measurements station installed at Shivee Gobi soum of Gobisumber aimag. During study data from the given station was disaggregated by each month

and dominating directions of wind speed, statistical indicators of wind speed, Weibull−Goodrich distribution function and individual power of wind speed were determined separately. Since the study shows that an average wind speed at the 20 meters altitude was 6.12 m/s, and 6.54 m/s at 30 meter altitude, a conclusion was made that there is a full opportunity to establish a large−scale wind park in this soum.

4.7

Dorjpurev J. (2008).

Renewable Energy Utilization and the Development of CDM Projects in Mongolia

Northeast Asia Energy Focus, Vol.5 No.1 Spring 2008. (pp 59−65)

Article, 7 pages, English

Keywords: renewable energy resources, greenhouse gases, clean development mechanism

Since power and heat production in Mongolia is based on coal, greenhouse gas emissions and air pollution is relatively high. The author emphasized that although Mongolia has rich solar, wind, water and geothermal resources, at present it is not able to utilize these resources in full measure. The article discussed renewable energy resources and presented main concepts of the National Program on renewable energy and the Law on Renewable energy approved by the SGH in order to create legal environment on utilization of renewable energy. Opportunities and problems for CDM implementation in renewable energy projects, possible CDM projects were examined.

4.8

Dorjpurev J., Janchiv M. (2007).

Renewable energy development in Mongolia.

A compilation of papers at the research conference on "Development of Mongolian fuel and energy sector" dedicated to the 85th anniversary of the Mongolian fuel and energy sector, (pp 78−84), Ulaanbaatar, Mongolia: "Munhiin useg" LLC

Paper, 7 pages, Mongolian

Keywords: National Program on renewable energy, Law on Renewable en−ergy, hydropower station, solar energy generator, wind power station, the UN convention on climate changes

The paper presents global trends in renewable energy development, the present state of renewable energy development in Mongolia, the main contents of the National Program on renewable energy, and Law on Renewable energy, present and future objectives put forward in the field of renewable energy.

Utilization of renewable energy resources in power production became a pressing issue for the global community. It can contribute not only to slowing down of global warming, but also to improved access of rural population to education, to its egagement in small−scale production and services, thus improving their living standards.

4.9

Dorjpurev J., Sanchin Ts. (2007).

The present state and future trends of renewable energy development.

A compilation of papers of the research conference on "Improving reliable operations of a power transmission network", (pp 364 − 368) Mongolia, Ulaanbaatar

Paper, 5 pages, Mongolian

Keywords: National Program on renewable energy, Law on Renewable energy, hydropower station, solar energy generator, wind power station

Present and future development objectives of renewable energy sector are presented in this paper. Progress of projects implemented in the field of renewable energy is summarized and future development trends are shown. Authors emphasize that using the main directions and the concept of the National program on renewable energy as a guidance, the Law on Renewable energy approved with an aim of expanding further work on support of solar, wind, water energy production and utilization, increase of assistance and support from donors, encouragement of private investment, reduction of prices and tariffs should be implemented productively.

4.10

The World Bank (2006).

Mongolia − Renewable Energy and Rural Electricity Access Project

http://www−wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/12/04/000020953_20061204102940/Rendered/PDF/37153.pdf

Project document, 95 pages, English

Keywords: Renewable energy, rural electricity supply, solar power generator, wind power generator

The development objective of the project is to increase access to electricity and improve reliability of electricity service among the herder population and in off−grid soum centers and also will help strengthen the capacity at the national level to develop renewable energy supplies. Other objectives such as providing financial assistance to herders in purchase of small renewable energy generators, improving power distribution networks in soums with RE sources, improving the structure and management of the soum centre power services, within 5 years providing 50000 households with small solar and wind generators were put forward.

4.11

Elliott D., Schwartz M., Scott G., Haymes S., Heimiller D., George R. (2001).

Wind Energy Resources Atlas of Mongolia Washington, USA

http://pdf.usaid.gov/pdf_docs/PNADE740.pdf

Book, 215 pages, English

Keywords: wind resources, wind speed, wind power station

When a wind study was conducted at the territory of Mongolia more than 160,000 km2 of windy land areas in Mongolia have been estimated to have good−to−excellent wind potential for utility−scale applications. The amount of windy land is about 10% of the total land area (1,565,000 km2) of the country. This amount of windy land, using conservative assumptions that result in about 7 megawatts (MW) of capacity per km2, could potentially deliver over 2.5 trillion kilowatt−hours (kWh) per year. Gobi aimags have

the highest wind potential and Umnugovi alone is estimated to have over 300,000 MW of potential.

The present wind energy atlas is a study of great significance in selecting appropriate places for construction of wind power stations.

4.12

Lyanhtsetseg S. (2001).

Study on selection of an optimal way of power supply of Mongolian regions with use of local energy sources.

MUST, School of Power Engineering.

Ph.D. thesis abstract, Mongolian

Keywords: renewable energy, wind energy, wind speed, wind power station, asynchronous generator

Evaluation of wind speed and individual capacity resources in Eastern and Southern regions of Mongolia (at altitude of 30 – 50 m), preliminary definition of locations where large – scale wind power stations can be built was carried out. The author conducted test studies of an asynchronous generator that can be used in wind and hydropower stations for small – scale independent users and a method of its restoration, management and power regulation. An issue of establishing zones for utilization of renewable energy resources of Mongolia and inclusion of renewable energy resources in the fuel and energy balance of the country was examined. The author also developed a rationale for utilization of wind energy in a large – scale power source.

4.13

Ulziitogtoh M., Boldbaatar B., Otgonchimeg T. (2008).

Research on use of hydropower, its implementation.

Papers of a National forum on Renewable energy (pp 27 – 37)
Ulaanbaatar, Mongolia.

Paper, 11 pages, Mongolian

Keywords: hydropower, hydropower station, reservoir, surge, calculated expenditure

The paper presented projects implemented in the last years by the National Centre of Renewable Energy and technical specifications of hydropower stations. Short technical indicators of Bogdo river hydropower station, Mankhan HPS in Hovd, Munkhkhairkhan HPS in Khovd, Tosontsengel HPS, Khungui river HPS in Zavkhanmandal, Galuutain river HPS in Tsetsen−Uul, were drawn up. A detailed feasibility study of the Chargatai HPS is presented. Such issues as study on selection of a HPS construction site, prospecting study at the project site, project selection options, water energy account, secure and additional power account, the station capacity and equipment selection were reviewed.

4.14

Purevdorj G. (1998).

Evaluation of Mongolian solar energy resources, study of a solar−power greenhouse in harsh continental climate conditions, development of its optimal version.

Technical University, Academy of Sciences, NAIRE

Ph.D.thesis abstract, Mongolian

Keywords: Solar energy resources, greenhouse, mathematical model, test greenhouse−stand, solar radiation

With use of the test and calculation method the solar energy resource distribution in Mongolia was estimated by regions, so the annual resource was evaluated as 2.2 − 10.12 MWatt. Based on the previous calculations a model of utilizing efficiently solar energy in greenhouses was developed and a design of a greenhouse with combined solar energy heating for cold continental climatic conditions was developed. A methodology of selecting suitable options of the geometric shape and size of the greenhouse depending on the geographic location was drawn out and a mathematical model expressing the greenhouse heating conditions was developed. With use of the above model the annual heat loss, a necessary amount of solar energy and additional heating was calculated and a technology of providing heating−lighting−water−fertilizers with combination of different energy sources was developed. A test greenhouse−stand to operate on solar energy was built and the real conditions of heating, agro atmosphere, solar radiation conditions were measured in the course of the whole year. Resources for using a solar greenhouse in weather conditions of our country

were defined and theoretical and practical work results of utilizing solar energy in heating greenhouses and seedlings in harsh climatic conditions of our country, creation and utilization of an independent system to operate on combination of solar and other energy sources were summarized.

4.15

Purevdorj G. (2002).

Development of science and technology of renewable energy

Ulaanbaatar, Mongolia, Soyombo printing LCC

Book, 122 pages, Mongolian

Keywords: Science of renewable energy, renewable energy resources, technology research

The present monograph contains research results of Mongolian renewable energy resources (solar, wind, water, biomass, geothermal) and their utilization in energy production. The public policy of developing the science and technology of renewable energy is reviewed and future development trends of renewable energy are looked at.

For energy experts, university students, MA students, lecturers and general public.

4.16

Purevsuren D. (2008).

Geothermal energy resources of Mongolia, possibilities for their utilization.

Papers of a National forum on Renewable energy (pp 43 — 47)
Ulaanbaatar, Mongolia.

Paper, 5 pages, Mongolian

Keywords: Geothermal energy

The paper presents review of research carried out by the Geothermal energy research team of the National Centre on Renewable Energy in 2001 — 2008. The main objective of the study was to examine possibilities

of geothermal energy utilization in energy production. As for Mongolia, in order to increase geothermal energy consumption certain works should be done, such as development of a master plan on use of geothermal energy resources, implementation of a model project, establishment of a geothermal station near Tsetserleg city of Arhangai aimag, geothermal exploration near large cities and settlements.

4.17

Tumen J. (2008).

Use of renewable energy in agriculture.

Papers of a National forum on Renewable energy (pp 74−80)
Ulaanbaatar, Mongolia.

Paper, 7 pages, Mongolian

Keywords: Wind energy, biomass energy, methanol, ethanol, biodiesel, biogas

The paper presents results of the study, tests and drawings on utilization of renewable energy in agriculture. An issue of solar, wind, biomass energy utilization was basically resolved and certain results were achieved in using solar energy in drawing water from wells, heating of animal pens and greenhouses. However, since until present there is lack of a special program or project on wide use of renewable energy in the agricultural sector, the author raises a question of taking this issue as a concrete measure in the frame of the national program on renewable energy. There is a great need for utilization of solar, wind, biomass energy in pastoral livestock breeding. That is why it is necessary to expand further the scope of studies, research, tests and drawings on this issue, to support it with special financing and investment, to establish a domestic plant on production of wind, solar and biogas energy equipment and tools.

4.18

Ministry of Justice and Home Affairs, Ministry of Fuel and Energy. (2007).

Law on Renewable Energy. National Program on renewable energy.

Ulaanbaatar, Mongolia.

Book, 31 pages, Mongolian, English

Keywords: Renewable energy, renewable energy fund, prices and tariffs of renewable energy, renewable energy resources

The Law on Renewable energy, adopted on November 11, 2007, the directive 32 of June 9, 2005 of the State Great Hural of Mongolia on approval of the National Program on Renewable Energy and the National Program on Renewable Energy approved by the above directive are included in this booklet in Mongolian and English.

4.19

Enebish N. (2008).

Use of renewable energy is a extremely important objective of sustainable development.

Papers of a National forum on Renewable energy (pp 6—10)
Ulaanbaatar, Mongolia.

Paper, 6 pages, Mongolian

Keywords: Sustainable development, renewable energy

The paper looks at the long—term sustainable economic and social development concept of the country and presents some achievements in the renewable energy sector with emphasis on wide opportunities and great demand for utilization of renewable energy in Mongolia. In relation to a need for new sources, an issue of changes in the structure and operations of heat and power stations that use coal and increasing further capacity of the stations needs to be resolved. In the course of resolving the above problems the whole energy system needs to be made more efficient and measures on improving the energy supply structure should be taken in a comprehensive way. The presently operating heat and power stations all should be renovated and changed by 2020. In the next decade a demand to renovate a

power station technology in our country gives a great opportunity to make big changes in the energy supply forms and such opportunities should be used to provide stable energy services.

4.20

Erdenebaatar A. (2008).

Establishment of a wind park in Mongolia.

Papers of a National forum on Renewable energy (pp 16 — 26)
Ulaanbaatar, Mongolia.

Paper, 11 pages, Mongolian

Keywords: Renewable energy, wind park, wind energy resources, wind re— sources distribution

The report presents results of the wind resource study in our country and determines regions appropriate for establishment of wind parks. Places with abundant and good wind resources are located at the territory of 36 soums in 6 aimags of our country. Of them in over 40 points in 5 aimags there are possibilities for establishment of large — scale wind parks that can be directly connected to the centralized energy grid. The most suitable places to utilize wind energy, i. e. places with wind speed over 6.4 m/s are divided into 3 regions. The first region is the total territory of Umnugobi aimag and a medium — scale wind park to operate along with the Dalanzadgad heat and power station can be established. The second region includes territories of Dornod and Dornogobi aimags and the South Eastern part of Sukhbaatar aimag. Establishment of a wind park in this region, for instance, near Sainshand soum in Dornogobi aimag is highly profitable in technical and economic aspects. The third region covers most part of Gobisumber, Tuv, Khentii, Sukhbaatar aimags as well as Bayankhongor, Gobi Altai and Dundgobi aimags. In this region a medium — scale wind park to operate along with the Taishir hydropower station needs to be established.

4.21

Japan International Cooperation Agency (2000).

Master Plan Study for Rural Power Supply by Renewable Energy in Mongolia. Final Report. Summary Tokyo, Japan, Nippon Koei Co., Ltd

Project report, 98 pages, English

Keywords: Rural power supply, renewable energy, solar power generator, wind power generator, small hydropower station, fuel element, hydrogen production

According to the master plan on power supply of rural areas of Mongolia with renewable energy by 2015 an objective of providing in total 167 soum centers with power will be achieved by the way of combining such different renewable energy resources as solar and wind power generators, small—scale hydropower stations, fuel elements and hydrogen production. In total 80490 million dollars is necessary to achieve the objective. According to author's calculations as a result of implementing the plan 6850 tons of fuel will be saved annually and carbonic acid gas emissions will be reduced by 5042 tons annually.

5 Fuel

5.1

Bilegsaihan J., Magvanjav B., Zorigt O., Byambadagva B., Oyuttsetsen E., Davaadorj M. (2002).

Coal demand at the global market, perspectives of coal production in Mongolia.

Ulaanbaatar, Mongolia

Book, 20 pages, Mongolian

Keywords: Coal, coal reserves, coal mining, coking coal, coal exporter, coal prices

On the basis of the statistical data the study presents global coal resources, coal mining, fluctuation of coal prices at the global market, the impact of the coal industry on global economy, its development trends, coal resources and mining in Mongolia, projections of coal prices at the market and coal exports. As for Mongolia, the author recommends to establish factories that produce value added products based on coal resources of the country, to use in full measure waste from coal mines making road and construction materials from it, to introduce technologies on full use of coal, to liberate coal prices, to produce petrol products from coal, to establish high power stations in order to export energy.

5.2

Davaasuren P. (2003).

Study to determine the optimal meaning of crushing of Baganuur coal.

MUST, SPE

Ph.D. thesis abstract, Mongolian

Keywords: The optimal meaning of coal crushing, the furnace dust preparation system, dust separator

The author carried out a study to develop a technical solution to be used in dust preparation system in order to find the best size for crushed lumps of Baganuur coal used at heat and power stations, to calculate economic profit from it, to conduct coal crushing within the limits of the best meaning. The best size for crushed lumps of Baganuur coal with regard to specifics of the furnace dust preparation system operations and the coefficient of extra air in furnace burners (if @=1.2) equals R_{90}= 39−41Mkm. If the meaning of crushing of Baganuur coal at heat and power stations is within R_{90}= 39−41 Mkm, total expenditure in burning of 1 ton of coal will reduce by 400−500 MNT. A TES−2500−900 dust separator was invented to use at heat and power stations that use Baganuur coal. When the dust crushing was done in large size or 39−41 mkm particles (the best size) deterioration of metallic components of the dust preparation system has declined, their exploitation time has increased, a problem of the weight of metallic elements to be changed during major and routine repairs and reduction of explosion and explosion pressure was studied. If exploitation expenses are calculated, savings of metal in crushing 1 ton of coal equals 450−550 MNT/ton in a BKZ−75−39 furnace, 200−250 MNT/ton in a BKZ−220−100 furnace with direct blow dust preparation system, 1000−1200 MNT/ton in a BKZ 220−100 furnace with an interim bunker.

5.3

The World Bank (2006).

Mongolia: A Review of Environmental and Social Impacts in the Mining Sector.

World Bank, Washington, USA
http://siteresources.worldbank.org/INTMONGOLIA/Resources/Mongolia−Mining.pdf

Book, 44 pages, English

Keywords: Mining sector, environmental impact, mine exploitation

The mining sector is a major contributor to the Mongolian economy, accounting for about 17 percent of GDP, 65 percent of industrial value added, and 58 percent of export earnings. In the last years major changes have taken place in the sector. Analysis of environmental and social impact of Mongolian mining sector is presented. The current environmental, social, regulatory, and institutional frameworks of the mining sector are reviewed and options for improvement are suggested.

The study put forward a strategy of more effective, environmentally–friendly utilization of mineral resources.

5.4

The World Bank (2006).

Mongolia – Coal Project

http://www–wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1996/04/09/000009265_3961022111453/Rendered/PDF/multi0page.pdf

Project document, 134 pages, English

Keywords: Coal mine, coal consumption, coal quality, local coal

The coal project has a main objective of increasing the capacity of the Baganuur coal mine up to 4 million tons in order to provide uninterrupted coal production in Mongolia. Along with this it aims to make the Baganuur shareholding company capable of financial independence, to increase effectiveness and power of mining equipment, and to create conditions for operating in an environmentally–friendly way. In the frame of the project in order to improve the Baganuur mine different activities will be implemented such as supply and installation of equipment, training on improvement of mine exploitation, on upgrading management, on developing financial and information systems.

5.5

National Mining Association of Mongolia (2006).

Mongolian Mining Directory.

Second printing. Ulaanbaatar, Mongolia, Hulegt Taij LLC

Book, 95 pages, Mongolian, English

Keywords: Mining company, equipment supplier, consulting company

The directory provides such information as addresses, telephone and fax numbers, e−mails and business fields of companies that have their own standing in the mining sector of our country and conduct sustainable activities, administrative and financial organisations that cooperate with them.

5.6

Ochirbat R., Gombosuren Ya., Tumurbaatar Z., Hayanhyarvaa E., Tsedendamba D., Tsend T., Chimed P., Jargalsaihan G. (2002).

Coal industry in Mongolia in the XX century.

Ulaanbaatar, Mongolia

Book, 240 pages, Mongolian

Keywords: Power management, investment project, planning, power sector audit, prices and tariffs, expenditure structure

This work, dedicated to 80th anniversary of the coal industry in Mongolia, has 6 chapters. The first chapter looks at the coal classification and gives evaluation of coal deposits, their location and reserves, the second chapter examines coal mining, historic traditions of its development, for instance a review of the Mongolian coal industry development, growth of professional staff in coal industry. The third chapter on "Thoughts about further development of the sector" looks at basic conditions of regionalized development of mining and studies on production of synthetic fuel from coal. The fifth chapter reviews environmental issues and restoration in the course of mining. The sixth chapter includes biographies of people, who worked in the management of the sector, information on Heroes of Labor and other famous people, a short introduction of research and academic works.

The book became an important directory of the sector since it contains a wealth of information and covers a wide range of historic development issues in 80 years of coal industry in Mongolia.

5.7

Tumurbaatar Z., Altanchimeg D. (2007).

The present and future of the energy sector.

A compilation of papers at the research conference on "Development of Mongolian fuel and energy sector" dedicated to the 85th anniversary of the Mongolian fuel and energy sector, (pp 17−26), Ulaanbaatar, Mongolia: "Munhiin useg" LLC

Paper, 10 pages, Mongolian

Keywords: coal mining, coal liquefying technology, coal methane gas, coal energy technology

Since in Mongolia large deposits of petrol and natural gas have not been yet discovered, coal is not only a source of fuel, but also an industry that has opportunities to become a competitive industry in the national economy. A concept of coal as only "fuel for the energy industry and other consumption" is revised and a brand new trend, for instance, laying grounds for establishment of coal processing industry is put forward as a short−term objective. Furthermore, a National "Coal" Program that determines an efficient, ecologically friendly, loss−free development of a large mineral sector in Mongolia is being developed. Large coal industry park, for instance, a complex of coal liquefying technology, a coal methane gas network, coking coal, chemical industry, brown coal energy technology complex are presented.

A conclusion is made that by implementing the above projects, programs and activities the social and economic development of Mongolia will accelerate, waste and loss in minerals sector will decrease greatly and introduction of economical, new technologies will become a new start of development in the coming century.

5.8

Japan International Cooperation Agency (1995).

Study on Comprehensive Coal Development and Utilization in Mongolia. Final Report. Summary. Tokyo, Japan.

Report, 101 pages, English

Keywords: Coal, coal mine, master plan, quality monitoring system, air pollution

The project report has two parts. The first part presents the study on renovation and improvement of coal mines in Shivee Ovoo, Baganuur, and the second part contains a study on development of a master plan of the coal industry development.

Based on the present condition of the coal mine in Shivee—Ovoo, Baganuur, the first part includes study on equipment necessary for further expansion and renovation of mines, renovation schedule, recommendations on improvement of coal quality and introduction of quality monitoring system, environmental issues, investment, operational costs and economic and financial study. The master plan on development of coal industry covers a wide range of studies on coal supply, the present consumption and future growth trends. The plan of coal mine development, projections of coal consumption, a plan on energy conservation depending on coal consumption, a plan on environmental protection, the structure and organization of management to implement the master plan, a study on human resources.

6 Energy, environment, ecology

6.1

Asian Development Bank (1998).

Asia Least−cost Greenhouse Gas Abatement Strategy (ALGAS) MONGOLIA

Manila, Philippines, ADB
http://www.adb.org/Documents/Reports/ALGAS/MON/default.asp

Book, 143 pages, English

Keywords: greenhouse gas, greenhouse gas abatement, energy production, energy consumption

In 1995−1998 the ADB implemented a project named "Asia Least−cost Greenhouse Gas Abatement Strategy" in 12 Asian countries with 9.5 million US dollar financing. In the frame of the project the present condition of greenhouse gas emission, its future trends and possibilities to reduce it were studied.

The book presents results of the greenhouse gas emission survey in Mongolia at the 1993 level, the projected level of greenhouse gas emission until 2020 and possibilities to reduce it.

The survey can be used to develop a program on mitigation of climate changes in

Mongolia, to learn about possibilities to reduce greenhouse gas emission, to develop proposals of projects in this field.

6.2

Asian Development Bank (2008).

Energy Conservation and Emissions Reduction from Poor Households

http://www.adb.org/Documents/GAR/MON/42059−MON−GAR.pdf

Project document, 32 pages, English

Keywords: Ger insulation, air pollution, fuel consumption

The impact of the Project will be improved quality of life in ger housing areas resulting from air quality improvement in Ulaanbaatar. The outcome will be a 50% reduction in the coal and firewood consumption of target households by the end of 2010. The output will be improved ger insulation for about 4,000 target poor households by the end of 2010.

The project activities include provision of highly insulated ger blankets for about 4,000 households in the ger district in Ulaanbaatar, training and consulting services, assessment to include this kind of project in Clean Development Mechanism (CDM) project.

6.3

Bat−Ulzii Ts., Enhjargal H., Haliunaa B. (2008).

Impact of low−pressure heating stoves on air pollution in Ulaanbaatar, ways to reduce it.

Heat equipment and production ecology institute Research works #10 (pp 183−192) Ulaanbaatar, Mongolia: "BEMBI FOUNDATION" Printing house

Article, 10 pages, Mongolian

Keywords: Air pollution, incomplete burning, low−pressure heating stove, pressed fuel

Out of 430 large and small heating and technological furnaces in Ulaanbaatar there are 250 boilers and 140 low pressure furnaces. Since the equipment and technology of these furnaces are outdated and their AUK

is low, they burn 250 thousand tons of coal annually and emit over 10 thousand tons of poisonous substances in the air, which becomes one of factors contributing to air pollution in Ulaanbaatar. That is why methods of renovating equipment and technology of the low pressures furnaces and increasing their AUK are studied in this paper.

A conclusion is made that renovation of low−pressure furnaces, reduction of heat loss and increased fuel quality can lead to reduction of air pollution in Ulaanbaatar by 50%.

6.4

Dorjpurev J. (2009).

Calculation of greenhouse gas emitted by the energy sector of Mongolia.

"Power & engineering" magazine, 2009−9(74) (pp 41−44) Ulaanbaatar, Mongolia

Article, 5 pages, Mongolian

Keywords: Energy sector, greenhouse gas, hydrogen gas, methane, nitrogen oxide, sulphuric dioxide

The article analyzes the volume of greenhouse gas emission in 1990−2006 in Mongolia. In 2006 the volume of carbon dioxide emitted from solid fuel burning equaled 729500 tons, of which 79.8% was taken by energy production emissions. The energy production sector accounts for the largest percentage of the greenhouse gas emissions at national level. While in 1990 it was 55.6% of total emissions, it grew up to 65.4% in 2006. Although the volume of greenhouse gas emitted by Mongolia is low compared to other countries, the volume of greenhouse gas per capita as well as that of per unit of wealth produced is relatively high. Production of national wealth causes emission of greenhouse gas, which is 10 times greater than the global average. On the one hand it is related to the unique climatic conditions of Mongolia, but on the other hand it illustrates a need to reduce coal consumption that causes greenhouse gas emission and make a transition to kinds of fuel with low emission of greenhouse gas, to renovate technologies of energy production and consumption, to conserve and effectively utilize energy.

6.5

Dorjpurev J. (2008).

Greenhouse Gas Emissions and the Mitigation Possibilities in the Energy Sector in Mongolia

Northeast Asia Energy Focus, Vol.5 No.4 Winter 2008. (pp 17−23)

Article, 7 pages, English

Keywords: Energy sector, greenhouse gas, clean development mechanism

The greenhouse gas calculation is made based on the three main greenhouses gases, namely CO2, CH4, N2O and other indirect greenhouse gases (CO, NO_X, NMVOC and SO_2) in 1990−2006. All gases emitted in the course of burning all kinds of fuel as well as gases emitted in the course of mining solid fuel are included in calculation of the greenhouse gas. All kinds of fuel burnt at national level are divided into following categories:

Energy production (heat and power production), industry and construction, transportation, public services, individual households, agriculture and forestry, others. Disaggregation of greenhouse gas calculation by sectors, by each of gases not only illustrates, which sector produces certain greenhouse gases, but also has great significance in developing policies and activities on reduction of greenhouse gas. Possibilities for reduction of greenhouse gas in the energy supply and consumption sector are reviewed in the article and methods of implementing clean development mechanism in Mongolia are examined.

6.6

Dorjpurev J., Battsend D. (1996).

Greenhouse Gas Mitigation Potenial in the Energy Sector of Mongolia

AMBIO (A journal of the human environment published by the Royal Swedish Academy of Sciences), Vol.25 No.4, 1996. (pp 254−357), MediaPrint, Uddevalla AB, Sweden.

Article, 4 pages, English

Keywords: Primary energy resources, greenhouse gas, greenhouse gas mitigation

The article studies energy production and consumption in Mongolia and the authors make calculations of greenhouse emission as well as explain opportunities for reduction of greenhouse gas. Two options of the energy sector development until 2020 are reviewed. According to the first option, energy production development is based on heat and power production with use of coal, as it is at present, according to the second option it develops by the way of introducing energy−saving, low−carbon technology. If the second option is implemented, the volume of gas will be reduced by 14% in 2010 and 19% in 2020.

6.7

The World Bank (2005).

Impact of improved stoves on indoor air quality in Ulaanbaatar, Mongolia

http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/04/21/000160016_20060421171709/Rendered/PDF/esm3130PAPER01051Mongolia1IAP01PUBLIC1.pdf

Project document, 76 pages, English

Keywords: air quality, air pollution, traditional stoves, improved stoves, coal consumption, dung, firewood.

Ulaanbaatar, Mongolia, is the coldest capital city in the world, with average winter low temperatures of −20° Celsius. In the ger districts of Ulaanbaatar, cooking and heating energy is provided through indoor coal combustion in metal stoves with chimneys, and in wintertime, such stoves may be in use both day and night. Over the last several years, new stove designs with improved fuel efficiencies have been introduced into many homes. To test the impact of the improved stoves on indoor air quality, 24−hour monitoring of particulate matter (PM) and carbon monoxide (CO) was done in 65 Mongolian gers. The primary analysis focused on 58 households, 20 with original (or traditional−type) stoves, 18 with the improved stove type TT−03, and 20 with the improved stove type G2−2000. In addition to indoor pollutant concentrations, information on other relevant factors was collected, which included home sizes, indoor and outdoor temperatures, the age of the stove in use, the amount of fuel used and the number of refueling, position of monitors relative to chimneys, and the number of cigarettes smoked in the home. Study results proved that improved stoves use less coal compared to the traditional old ones.

6.8

The World Bank (2002).

Mongolia: improved space heating stoves for Ulaanbaatar

http://www−wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2003/01/07/000094946_02122504001681/Rendered/PDF/multi0page.pdf

Project document, 64 pages, English

Keywords: air quality, air pollution, improved stoves, coal quality, coal consumption, dung, firewood.

Over the 1999−2001 period, the World Bank together with a Mongolian team assessed the situation in terms of household heating habits and consumption levels, kinds of stoves, ger heat need and technical feasibility of stove production. Improved stoves and stove components (kits) were designed and tested in real−life situations in 40 households, and the final improvements to be disseminated within the project were selected−the models that will make possible the reduction, by at least one−third, of coal consumption and, as a consequence, atmospheric pollution. Objectives were put forward for the widespread dissemination of these improvements among the 70,000 *ger* households in Ulaanbaatar. In order to achieve the goal a number of measures were taken such as extending credit to buyers, offering free training in effective use of the stove and establishing special points for sale of stoves.

6.9

Mangal S., Boldhuu N., Tugsbayar S., Tumurhuyag U., Batbaatar Ts. (2007).

Ecologically clean fuel production.

Papers of the research conference on "Development of fuel and energy sector " (pp 320−329) Ulaanbaatar, Mongolia: "Munhiin Useg" LLC

Paper, 10 pages, Mongolian

Keywords: Coal, coal gasification, semi−coking coal

The paper shows how present technologies used at heat and power stations, which burn solid and liquid fuel, cause air and soil environment pollution

in large measure on the example of the air pollution in Ulaanbaatar city on the basis of statistical data. Ecologically pure methods and technologies of coal processing are presented. Research results of an ecologically clean fuel production project based on the present heat and power station 2 TUHK are given. According to the author's calculations, if the project is implemented, 540 thousand tons of coal will be processed a year, producing 216 thousand of semi−coking coal, 432 million cubic meters of coking gas, 125 million Kwt of power and 123 thousand Gkal of heat.

The author views that by establishing ecologically clean production reviewed in the project the problem of air pollution can be resolved with the least investment and the best technology of coal utilization can be introduced in Mongolia.

6.10

Norov N. (2008).

A problem of greenhouse gas waste to be emitted by the Chinese power station built in Shivee Ovoo.

Heat equipment and production ecology institute Research works #10 (pp 215−222) Ulaanbaatar, Mongolia: "BEMBI FOUNDATION" Printing house

Article, 8 pages, Mongolian

Keywords: Greenhouse gas waste, sulphuric dioxide

The author looks at some indicators of the Shivee Ovoo coal, impact of its burning at the power station on atmosphere, ways to reduce greenhouse gas emission, some technology issues and concludes that replacement of power stations using coal by nuclear energy source will reduce greenhouse gas volume and give 25 million tons of carbonic acid.

The author also views that price of 25 million tons of carbonic acid from Shivee Ovoo coal station will be 390 million dollars, which means that the investment in this station will repay in 3.9 years, so China will return its investment in the station construction in only 3.9 years and then it can use the Shivee Ovoo coal free of charge to produce power for its own needs. We need to plant trees on 3.6 hectares in order to dispose of carbonic acid gas to be emitted by the station and pay annually 375 million dollars as fine for carbon to a country that will build a nuclear or a hydropower station.

6.11

Tseyen−Oidov J. (2007).

Power production at Heat and power stations of the Central power system of Mongolia and natural environment.

Papers of the research conference on "Development of fuel and energy sector " (pp 302−313−26) Ulaanbaatar, Mongolia: "Munhiin Useg" LLC

Илтгэл, 12 хуудас, монгол

Keywords: HPS, power system of the central region, individual expenditure of exemplar fuel, AYK, greenhouse gas, high−volatile coal, sulphuric acid, carbon monoxide, nitric oxide

In the first part of the report an analysis of main technical and economic indicators of heat and power stations of the power system in the central region in the last 15 years is made. The second part of the report shows greenhouse gas and air pollutant substances emitted by heat and power stations in the course of coal burning such as high−volatile coal, sulphuric acid, carbon monoxide, nitric oxide by five heat stations in 1992−2006.

A conclusion is made that there is a need to develop national standards of pollution on the basis of test studies of pollutants contents in the smoke caused by fuel burning at heat and power stations and the volume of poisonous substances emitted in the air along with the smoke should be defined in relation to that of one ton fuel and one Mdg heat produced in the course of fuel burning.

6.12

Enkhbayar Sh. (2005).

Opportunities for Pollution−Free Development: CDM Projects May Sure in Mongolia.

ERINA REPORT 2005, November Vol.66 (pp 48−53)
http://www.erina.or.jp/jp/Library/er/pdf/Er66.pdf

Article, 6 pages, English

Keywords: Climate changes, greenhouse gas, clean development mechanism, energy supply, energy consumption

Statistics on green house gas emission in Mongolia are shown and possible measures to be taken in order to reduce green house gas, especially that emitted by the energy sector are classified by energy supply and consumption. Activities initiated by the north east Asian economic Institute in the field of implementing CDM in North East Asian countries are mentioned and specifics of member countries are described.

The author emphasizes that there are abundant resources and opportunities for implementing CDM approved by the Kioto protocol in North East Asian countries, especially in the energy sector of Mongolia.

Summary of information (by alphabetical order of authors' names)

№	Author's name	Author's address, contact information	Year	Name of the work	Form and purpose of the work	Number of pages	Language	Keywords	Classification	Sector
1	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2002	Completion Report on the Energy Conservation Project	Project document	37	English	Energy conservation, heat loss, heat supply	1.1	General energy issues
2	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2002	Capacity Building in Energy Planning: Final Report, Volume I: Executive Summary	Project report	69	English	Energy planning, master plan of energy sector, energy balance	1.2	General energy issues
3	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2009	Demonstration Project for Improved Electricity Services to the Low Income Communities in Rural Areas	Project document	37	English	One-line power transmission system, rural power supply	2.1	Power
4	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2005	Electricity Sectors in CAREC Countries. A Diagnostic Review of Regulatory Approaches and Challenges	Book	92	English	Power, energy regulation, power tariffs	2.2	Power
5	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2008	Project Completion Report Ulaanbaatar Heat Efficiency Project	Project document	42	English	Heat supply, heating effectiveness	3.1	Heating
6	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2007	Community-Based Heating Supply in Rural Remote Areas		35	English	Heating stove, carbonic acid gas, coal	3.2	Heating

7	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2002	Renewable energy development in Small towns and Rural areas in Mongolia	Project document	12	English	Rural power supply, renewable energy	4.1	Renewable energy
8	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2005	Hydrothermal Heat Supply of Province Center	Study report	31	English	Geothermal sources, centralized heat supply	4.2	Renewable energy
9	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2006	Wind Energy Supply for Off-grid Small Town	Study report	31	English	Wind energy, wind power station, wind resources, wind speed	4.3	Renewable energy
10	Asian Development Bank	Tel:329836 www.adb.org/mnrm	1998	Asia Least-cost Greenhouse Gas Abatement Strategy (ALGAS) MONGOLIA	Book	143	English	Greenhouse gas, greenhouse gas abatement, energy production, energy consumption	6.1	Energy, environment, ecology
11	Asian Development Bank	Tel:329836 www.adb.org/mnrm	2008	Energy Conservation and Emissions Reduction from Poor Households	Project document	32	English	Ger insulation, air pollution, fuel consumption	6.2	Energy, environment, ecology
12	Altangerel T., Dorjpalam M.	"Ulaanbaatar heating network" Ltd www.dhc.mn	2009	A need to reduce apartment building heat loss, its benefits.	Paper	9	Mongolian	Heat transmission, heat loss, insulation loss, loss through insulation, loss through air penetration	3.3	Heating
13	US Agency for International Development	P.O. Box 1021 Ulaanbaatar 13 Mongolia Tel: 312390 Fax:310440 www.usaid.gov/mn	2003	Mongolia's Energy Sector Commercialization and Privatization Program	Project study report	44	English	Structural reform, commercialization, privatization, energy tariffs, energy regulation, license owner	1.3	General energy issues

14	US Agency for International Development	P.O. Box 1021 Ulaanbaatar 13 Mongolia Tel: 312390 Fax:310440 www.usaid.gov/mn	2002	Commercialization Initiatives at Darkhan-Selenge Electric Distribution Network	Book	71	English	Energy sector, structural reform, commercialization, privatization, energy tariffs, energy regulation, license owner	2.3	Power
15	US Agency for International Development	P.O. Box 1021 Ulaanbaatar 13 Mongolia Tel: 312390 Fax:310440 www.usaid.gov/mn	2004	Preliminary Market Assessment for Heat-Only Boilers in Mongolia	Project study report	50	English	Heating stove, burning efficiency, combined heat and power production	3.4	Heating
16	Arslan J.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Research and development of a method to improve precision of two-sided identification method for failure point in overhead /aerial/ transmission grid of 110 kW and higher.	Ph.D. thesis abstract		Russian	Aerial power transmission line, method to identify a failure point, two-sided measurement, parameters of the time of accident	2.4	Power
17	Ministry of Environment and tourism. Developing and realization of capacity building of carbon financing projects	Tel: 266314 www. cdm-mongolia.com E-mail: info@cdm-mongolia.com	2009	Market Survey of Heat-only Boilers and Coal-fired Water Heaters.	Book	51	Mongolian	Water heater stove, heat supply system, heating network, stove production, smoke gas, coal spending, air pollution, heat stove standards	3.5	Heating
18	Batjargal Ts.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2006	Developing methodology and scientific non-linear mathematic models for investigating Mongolia's energy demands growth and supply.	Ph.D. thesis abstract		Mongolian	Energy consumption, growth dynamics, energy reserve, mathematical model, programming, fuel and power balance	1.4	General energy issues

19	Batmunh S., Enhjargal H., Demberel D.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Technological Progress in Mongolia's Energy sector, innovations 85.	Book	380	Mongolian	Technological progress, innovation, innovators, advanced technique and technology, constructive ideas	1.5	General energy issues
20	Bat-Ulzii Ts., Enhjargal H., Haliunaa B.	MUST, Heating equipment and production Ecology Institute www.must.edu.mn	2008	Impact of low-pressure heating stoves on air pollution in Ulaanbaatar, ways to reduce it.	Article	10	Mongolian	Air pollution, incomplete burning, low-pressure heating stove, pressed fuel	6.3	Energy, environment, ecology
21	Bathuyag S.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	1997	Scientific-methodological and practical problems of working out Mongolia's energy development strategy in new socio-economic conditions	Sc.D. thesis abstract		Mongolian	Energy sector, development strategy, fuel-power supply	1.6	General energy issues
22	Bathuyag S.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2009	Development strategy of energy sector: Theory and methodology, some practical issues.	Book	362	Mongolian	Energy sector, energy industry	1.7	General energy issues
23	Bathuyag S., Enhjargal H., Purevdorj G.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Past and present of Mongolia's energy sector, its short-term development strategy	Paper	15	Mongolian	Energy industry, development strategy	1.8	General energy issues
24	Bat-Erdene B.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2005	Developing a method for identification of failure point on 110-220 kW overhead electricity transmission line	Ph.D. thesis abstract		Russian	Overhead electricity transmission line, its failure, sensory coefficient	2.5	Power

25	Bayarbaatar Ts.	Energy department www.ea.energy.mn	2009	Projects and programs implemented in energy sector.	Article	7	Mongolian	Energy sector, project, program, investment, loan, assistance	1.9	General energy issues
26	Bilegsaihan J., Magvanjav B., Zorigt O., Byambadagva B., Oyuttsetsen E., davaadorj M.	MRPAM, Tel: 263709 http://mrpam.gov.mn	2002	Coal demand at global market, perspectives of Mongolian coal production.	Book	20	Mongolian	Coal, coal resources,coal mining, coking coal, coal exporter, coal prices	5.1	Fuel
27	Bum-Ayush M.	Energy corporation E-mail: erchim_cor@mongol.net	2009	Historical chronology of energy sector research and intellectual organizations' – 50 years.	Book	208	Mongolian	Fuel, energy, mining, research, drawings	1.10	General energy issues
28	Byamba-Ochir D.	"Ulaanbaatar heating network" Ltd www.dhc.mn	2009	Inception and development of centralized heat supply in Mongolia	Paper	6	Mongolian	Centralized heat supply system, heating, heating network	3.6	Heating
29	Byamba-Ochir D	"Ulaanbaatar heating network" Ltd www.dhc.mn	1999	Research and elaboration of ways to increase centralized heat supply system effectiveness in regions with harsh continental climate.	Ph.D. thesis abstract		Mongolian	Centralized heat supply system, heat transmission, hydraulic regime of heat supply system, heat loss, дулааны дэд өртөө	3.7	Heating
30	Ganbaatar B., Boldsaihan S., Ganzorig B.	MUST, SPE www.must.edu.mn tel:323579 fax:323579	2008	Converting furnace BKZ-75-FB at boiling layer to fuel burning technology project, its outputs and significance	Article	11	монгол	Heat and power station, boiling layer burning technology, nitric oxide, air distributor	3.8	Heating
31	Ganjuur R.	ERA, Tel: 319335 info@era.energy.mn www.rea.energy.mn	2007	Study of modern management methods introduced in energy sector	Paper	20	Mongolian	Market, tariffs, benchmarking, sales income	1.11	General energy issues

32	Ganjuur R., Be−hbayar D.	ERA, Tel: 319335 info@era.energy.mn www.rea.energy.mn	2008	Modern day energy managers.	Book	225	Mon−golian	Energy sector, energy manager	1.12	General energy is−sues
33	Gantogoo Yo.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Method of choos−ing an appropriate variant of regional electricity sup−ply (On example of Mongolia's Eastern region)	Ph.D. thesis abstract		Mon−golian	Power supply, power consumption, non−linear mathematical imitation, non−linear mathematical model	2.6	Power
34	Gantumur Sh.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2005	Developing meth−ods, algorithms and mathematic models of computing fixed conditions of elec−tricity /On the ex−ample of Mongolian energy system/	Ph.D. thesis abstract		Mon−golian	Power system, fixed conditions, math−ematical model, al−gorithm, linear model, non−linear model	2.7	Power
35	Ganhuyag D., Purevdagva N., Ligden M.	Newcom LLC, www.newcom.mn	2008	Results of study on establishment of the wind park, its feasibility, obstacles faced	Paper	4	Mon−golian	Wind park, wind speed daily	4.4	Renewable energy
36	Ganchimeg M., Battushig G., Ulambadrah B., Bayarhuu E.	ERA, Tel: 319335 info@era.energy.mn www.rea.energy.mn	2007	On the issue of coordination of price and tariffs on re−newable energy.	Paper	14	Mon−golian	Renewable energy, renewable energy prices and tariffs, wind park, hydro−power station, solar power station	4.5	Renewable energy
37	German techni−cal cooperation association	Tel: 315340, 315341 Fax: 31534−2 E−mail: gtz−mon−golei@gtz.de	2009	Legal handbook on exploitation of heat furnaces	Book	296	Mon−golian	Heat stoves, heat supply standards, technical require−ments, smoke com−position, heat pipes	3.9	Heating

38	Davaasambuu Ch.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2001	Experimental study of low capacity heat generator	PhD thesis abstract		Mon−golian	Heat supply sys−tem, low capacity heat generator, heat exchange, fire sphere, efficiency coefficient, heat exchange multi−plier	3.10	Heating
39	Davaasuren P.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2003	Study to determine the optimal mean−ing of crushing of Baganuur coal.	PhD thesis abstract		Mon−golian	Optimal size of coal crushing, the furnace dust preparation sys−tem, dust separator	5.2	Fuel
40	Davaasuren Ch., Baatarhuu M.	MUST, School of Ma−terials Technology mbkhuu@must.edu.mn cdav@must.edu.mn	2008	Establishment of a large−scale wind park in Shiveegovi soum of Govisumber aimag.	Paper	8	Mon−golian	Wind energy, wind resources, wind speed, wind speed direction	4.6	Renewable energy
41	Dansranjav P.	MUST, Heating equip−ment and production Ecology Institute www.must.edu.mn	2008	Mongolia's increas−ing energy con−sumption demand.	Article	23	Mon−golian	increasing energy consumption, energy balance, power sup−ply, heat supply	1.13	General energy is−sues
42	Dorjpurev J.	"EEC" LLC tel:330968 mecc@magicnet.mn	2008	Renewable Energy Utilization and the Development of CDM Projects in Mongolia	Article	7	English	Renewable Energy resources, greenhouse gas, clean develop−ment mechanism	4.7	Renewable energy
43	Dorjpurev J.	"EEC" LLC tel:330968 mecc@magicnet.mn	2009	Calculation of greenhouse gas emission in energy sector of Mongolia.	Article	5	Mon−golian	Greenhouse gas, carbonic acid gas, methane, nitric oxide, sulphuric dioxide	6.4	Energy, environ−ment, ecology
44	Dorjpurev J.	"EEC" LLC tel:330968 mecc@magicnet.mn	2008	Greenhouse Gas Emissions and the Mitigation Possi−bilities in the Energy Sector in Mongolia	article	7	English	Energy sector, greenhouse gas, clean development mecha−nism	6.5	Energy, environ−ment, ecology

45	Dorjpurev J. , Battsend D.	"EEC" LLC Tel:330968 mecc@magicnet.mn	1996	Greenhouse Gas Mitigation Potenial in the Energy Sector of Mongolia	Article	4	English	Primary energy re−sources, greenhouse gas, greenhouse gas mitigation	6.6	Energy, environ−ment, ecology
46	Dorjpurev J., Janchiv M.	"EEC" LLC tel:330968 mecc@magicnet.mn	2007	Renewable en−ergy development in Mongolia	Paper	7	Mon−golian	Hydropower station, solar power generator, wind power sta−tion, climate change convention	4.8	Renewable energy
47	Dorjpurev J. , Sanchin Ts.	"EEC" LLC Tel:330968 mecc@magicnet.mn	2007	Present situation of renewable energy development, its future trends.	Paper	5	Mon−golian	National program on renewable energy, law on renewable energy	4.9	Renewable energy
48	Douglas Bowman	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2006	Comments to the Generator's Two−Part Tariff Method−ology	Project study report	28	English	Power tariff, energy tariff, two−part tariff, power production license owner	2.8	Power
49	Douglas Bowman	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2008	Comments to the tariff reform plan proposal for the central energy system	Study report	59 − 61 pp	Mon−golian, English	Tariff, cross− sub−sidy, energy market, livelihood level tariff, time−varying tariff	2.9	Power
50	Douglas Bowman	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2006	Review of Inter−national experi−ence with incen−tive regulation − for application in Mongolia's elec−tricity transmission and distribution sectors	Project study report	41	English	electricity trans−mission network, electricity distribution network, structural reform, commer−cialization, energy regulation	2.10	Power

51	Douglas Bowman	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2008	Proposed competi−tive power market design for Mongo−lia's Central Power System	Study report	62 and 68	Mon−golian, English	Single buyer, special licensee, model of electricity selling buying market, system and market operator	2.11	Power
52	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	1995	Mongolia energy sector review	Book	88	English	Energy supply, coal, power, heat, power distribution, cen−tralized heat supply, renewable energy, energy consumer	1.14	General energy is−sues
53	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2002	Energy Sector	Ном	8	English	Coal, liquid fuel, gas fuel, energy resources, sustainable energy development strategy	1.15	General energy is−sues
54	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2001	Mongolia − Energy efficiency in the electricity and dis−trict heating sectors	Project document	40	English	Power production, power transmission, power distribution, energy efficiency, heat production, central−ized heat supply	1.16	General energy is−sues
55	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2001	Mongolia − Energy Project	Project document	71	English	Energy sector, energy system, power supply, power transmission, power distribu−tion, heat distribution, energy policy	2.12	Power
56	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2006	Mongolia − Re−newable Energy and Rural Electricity Access Project	Project document	95	English	Renewable energy, rural power supply, solar power generator, wind power generator	4.10	Renewable energy

57	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2006	Mongolia: A Review of Environmental and Social Impacts in the Mining Sector	Book	44	English	Mining sector, environmental impact, mine exploitation	5.3	Fuel
58	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2006	Mongolia − Coal Project	Project document	134	English	Coal mine, coal consumption, coal quality, local coal	5.4	Fuel
59	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2005	Impact of improved stoves on indoor air quality in Ulaanbaatar, Mongolia	Project document	76	English	Air quality, air pollution, traditional stoves, improved stoves, coal consumption, dung, firewood.	6.7	Energy, environment, ecology
60	World Bank	MCS Plaza Bldg Seoul Street−4 Ulaanbaatar Tel: 312647 www.worldbank.org.mn	2002	Mongolia: improved space heating stoves for Ulaanbaatar	Project document	64	English	Air quality, air pollution, improved stoves, coal quality, coal consumption, dung, firewood.	6.8	Energy, environment, ecology
61	Yondongombo G.	Energy agency www.ea.energy.mn	1999	Technology of furnace ignition by fuel plasma burst not with heavy oil. (On example of trail test at boiler BKZ−420−140−10C Ulaanbaatar HPS−4).	Ph.D. thesis abstract		Russian	Heat and power station, mazut (heavy oil), ignition of furnace, ratio of coal and air, fuel plasma burning	3.12	Heating
62	Jamyandorj P.	"Power transmission system of the central region" Ltd	2003	Research and perfection of monitoring and measurement system of heat generation plants	Ph.D. thesis abstract		Russian	Heat station, normal regime, accident regime, measuring and monitoring system, relay protection automatic instruments, micro−processor	2.13	Power

63	Jargalhuu L.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2005	Study of highly effective heat generation plants for Mongolia's heat power station.	Ph.D. thesis abstract		Russian	Solid fuel, gasification of solid fuel, furnace efficiency coeffi−cient multiplier, heat generator	3.11	Heating
64	James P. Rizer, Garry Vollans	USAID www.usaid.gov/mn	2002	Contributions to Mongolia's Sus−tainable Energy Strategy: 2003−2010.	Book	384 ба 328	Mon−golian, English	Sustainable develop−ment, energy sector, energy market, energy savings, energy ser−vices	1.17	General energy is−sues
65	Zagdhorol B.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2004	Optimization of Mongolia's energy system regime by its activated capacity.	Ph.D. thesis abstract		Russian	Energy system, system regime, load, load distribution, real ca−pacity, optimization	2.14	Power
66	Zunduisuren Ch, Gantogoo Yo.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2002	Energy management.	book	313	Mon−golian	Energy management, investment project, planning, energy au−dit, prices and tariffs, expenditure structure	1.19	General energy is−sues
67	Zunduisuren Ch., Enhjargal H., Tleihan A., Enh−tur D., Amarzaya A.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Cause of lighting the hearth (Photo album and reference book)	Book	330	Mon−golian	Fuel and en−ergy sector, бүтээн байгуулалт, хамт олон, салбарын түүхэн хөгжил	1.20	General energy is−sues
68	Zunduisuren Ch., Enhjargal H., Bayarsaihan G.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2009	Theory and meth−odology of increas−ing efficiency of energy development planning	Paper	12	Mon−golian	Planning, future prospects, electricity load, electricity con−sumption, heat load, heat consumption	1.18	General energy is−sues
69	Intergovernmen−tal Collaborative Mechanism on Energy Cooper−ation in North−East Asia (2006)	Korea Energy Econom−ics Institute Tel: (8231)420−2252 Fax:(8231)420−2163	2006	Energy policy and Statistics in North−east Asia	Book	259	English	North East Asia, energy cooperation, power balance, energy resources	1.21	General energy is−sues

70	Intergovernmental Collaborative Mechanism on Energy Cooperation in North-East Asia (2006)	Korea Energy Economics Institute Tel: (8231)420-2252 Fax:(8231)420-2163	2007	Country Report on energy outlook in Northeast Asia	Book	178	English	North East Asia, future energy development, regional energy demand	1.22	General energy issues
71	Elliott D., Schwartz M., Scott G., Haymes S., Heimiller D., George R.	National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 Tel:800.553.6847 http://www.ntis.gov/ordering.htm	2001	Wind Energy Resource Atlas of Mongolia	Book	215	English	Wind resources, wind speed, wind power station	4.11	Renewable energy
72	Landannorov N.	Mon-Energy Consult E-mail: landa@mon.energy.mn	2007	Energy efficiency study of straw-bale and retrofitted building in Mongolia.	Study report	67	Mongolian, English англи	Straw-bale, straw-bale building, retro-fitted building, heat providing coefficient, calculated heat load	1.23	General energy issues
73	Lhagvasuren L.	Darhan, School of Energy	2007	Development stages of Mongolia's energy network, its future perspectives.	Paper	5	Mongolian	electricity network, conductor cross section, economic density of current, technical-economic nomogramm	2.15	Power
74	Lyanhtsetseg S.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2001	Study on selection of an optimal way of power supply of Mongolian regions with use of local energy sources	Ph.D. thesis abstract		Mongolian	Renewable energy, wind energy, wind speed, wind power station, asynchronous generator	4.12	Renewable energy
75	Mangal S., Boldkhuu N., Tugsbayar S., Tumurkhuyag U., Batbaatar Ts.	ЭХЭБЯ Утас: 261511	2007	Ecological fuel production.	Paper	10	Mongolian	Coal, coal gasification, semi-coking coal	6.9	Energy, environment, ecology

76	National Council on Sustainable Development	Tel: 328151 agenda21@magicnet.mn www.mongoliaonine.mn/map21	1999	Modeling of energy planning	Book	21	Mongolian	Energy consumption, energy and power system, energy consumption structure, an option of future trend, energy production and consumption, theoretic model of energy supply	1.24	General energy issues
77	Mongolian Mining Association	Tel: 314877 info@miningmongolia.mn www.miningmongolia.mn	2006	Mining Directory	Book	95	Mongolian , English	Mining company, equipment supplier, consulting company	5.5	Fuel
78	Namkhainyam B.	MUST,SPE www.must.edu.mn Tel:323579 Fax:323579	2008	Urgent development issues of heat supply in urban areas of Mongolia.	Article	12	Mongolian	Heating, average capacity heating systems, low capacity hydrothermal stoves	3.13	Heating energy
79	Namkhainyam B.	MUST,SPE www.must.edu.mn Tel:323579 Tel:323579	2007	On the issue of improving the structure of generators at Heat and Power Stations and increasing efficiency of heating system.	Paper	9	Mongolian	HPS, individual fuel spending, heating network, the network water consumption, heating	3.15	Heating
80	Namkhainyam B., Amarbat L.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2009	Demand for thermal energy in Ulaanbaatar and ways to meet it.	Paper	12	Mongolian	Thermal generator, centralized heat supply, capacity balance, heat duty, hydrothermal stove, home stove	3.14	Heating
81	Norov N.	NUM, ЦТС	2008	A problem of greenhouse gas waste to be emitted by the Chinese power station built in Shivee Ovoo.	Article	8	Mongolian	Greenhouse gas waste, sulphuric dioxide	6.10	Energy, environment, ecology

82	Nuurei B.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	1996	Methods and mathematic models of systematic analysis of development of emerging electric energy system.	Ph.D. thesis abstract		Russian	Fuel, energy complex, energy system, systematic analysis method, mathematic model	2.16	Power
83	Ochirbat R., Gombisuren Ya., Tumurbaatar Z., Khayankhyarvaa E., Tsedendambaa., Tsend T., Chimed P., Jargalsaikhan Kh.	MUST, School of Mining, Engineering Sustainable Development and Ecology Center	2002	Coal industry in Mongolia in the XX century.	Book	240	Mongolian	Power management, investment project, planning, power sector audit, prices and tariffs, expenditure structure	5.6	Fuel
84	Ulziitogtookh M, Boldbaatar B., Otgonchimeg T.	NCRE miidree@yahoo.com	2008	Research on use of hydropower, its implementation.	Paper	11	Mongolian	Hydropower, hydropower station, reservoir, surge, тооцоот зарцуулга	4.13	Renewable energy
85	Unurmaa Ts.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Investigation of mathematic models and methods for computing and analysis of fixed regimes of Mongolia's energy system. Energy Institute of Siberian branch of Russian Academy of Sciences.	Ph.D. thesis abstract		Russian	Prompt dispatcher management, fixed regime, accident regime, after accident regime (procedure), reliability of energy system, capacity balance, electric circuit balance	2.17	Power
86	Purevdorj G.	Energy Agency Tel: 341371 purevdorj@mobinet.mn	2008	Energy science	Book	223	Mongolian	Science and technology, energy industry, renewable energy	1.25	General energy issues

87	Purevdorj G.	Energy Agency Tel: 341371 purevdorj@mobinet.mn	1998	Evaluation of Mon−golian solar energy resources, study of a solar− power greenhouse in harsh continental cli−mate conditions, development of its optimal version.	Ph.D. thesis abstract		Mon−golian	Solar energy re−sources, greenhouse, mathematical model, test greenhouse−stand, solar radiation	4.14	Renewable energy
88	Purevdorj G.	Energy Agency Tel: 341371 purevdorj@mobinet.mn	2002	Development of science and tech−nology of renewable energy	Book	122	Mon−golian	Science of renew−able energy, renew−able energy resources, technology research	4.15	Renewable energy
89	Purevsuren D.	Energy Agency puu−jeemoogii@yahoo.com	2008	Geothermal energy resources of Mon−golia, possibilities for their utilization.	Paper	5	Mon−golian	Geothermal energy	4.16	Renewable energy
90	Sodnomdorj D.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	1995	Developing a complex method of computing loss of Mongolia's electric energy network and measures to reduce it.	Sc.D. thesis abstract		Russian	Electricity network, loss electric energy	2.18	Power
91	Sodnomdorj D.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Current status of Mongolia's energy, future trend.	Paper	18	Mon−golian	Energy complex, se−curity, price and tariff, optimal meaning, fu−ture trend, renewable energy, privatization, investment activi−ties, micro−system, structure, atomic powerr station	2.19	Power

92	Sodnomdorj D.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2009	On improvement of technical and economical efficiency of capital city electricity network	Paper	7	Mongolian	Electricity network, energy loss, technical loss, marketing loss	2.20	Power
93	Sukhbaatar U.	MECS, Tel: 260721 sukhee@mecs.gov.mn	1996	Study of the abrasive deterioration process of furnace equipment and development of protection methods	Ph.D. thesis abstract		Russian	Heat and power station, abrasive deterioration, coal characteristics	3.16	Heating energy
94	Sukhbaatar Ts., Tumurbaatar Z., Batrenchin SH., Tugsbayar S.	Mongolian Energy Association sukhbaatar@mobinet.mn	2007	Tariff Methodology for the Energy Sector of Mongolia	Paper	10	Mongolian	Energy sector, structural changes, energy tariff, energy regulation, energy regulation office, special licensee	1.26	General energy issues
95	Sergelen B.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2000	Electric drive with two synchronous motors supplied from one current type frequency converter	Ph.D. thesis abstract		English	Synchronous motor, speed regulator, electric transmission, frequency converter	2.21	Power
96	Tleihan A.	MP	2009	Mongolia's development policy, pressing issues in energy sector and legal environment.	Article	4	Mongolian	Development policy, mines, energy, integrated system of energy	1.27	General energy issues

97	Thomas V. Smith	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2003	Tariff Methodology for the Energy Sector of Mongolia	Book	208	English англи	Energy sector, structural changes, energy tariff, energy regulation, energy regulation office, special licensee	1.28	General energy issues
98	Tumurbaatar Z., Altanchimeg D.	ЭБЭХЯ, Tel: 261511 altaa@mfe.energy.mn	2007	The present and future of the energy sector	Paper	10	Mongolian	Coal mining, coal liquefying technology, coal methane gas, coal energy technology	5.7	Fuel
99	Tumen J.	Agriculture Technical Science and Technology, production unit	2008	Use of renewable energy in agriculture.	Paper	7	Mongolian	Wind energy, biomass energy, methanol, ethanol, biodiesel, biogas	4.17	Renewable energy
100	Tumentsogt Ts.	World Bank Tel: 312647 www.worldbank.org.mn	2007	Mongolia Energy Strategy: Current Status and Programs	Article	8	English	Energy strategy, energy cooperation, North East Asia, sustainable development of energy	1.29	General energy issues
101	Frank Pool, Erdenedalai L.,	Mon-Energy Consult E-mail; mon-energy@mongol.net	2007	Commercialization of Super-Insulated Buildings in Mongolia - UNDP, GEF Project MON/99/G35. Final Independent Evaluation Report	Тайлан	39	English англи	Supper-insulated private house, heating, heat loss, straw-bale, straw-bale building	1.30	General energy issues
102	Hand-Ish J.	Mongolian Energy Association www.ea.energy.mn	1998	Increasing reliability and effectiveness of continuous operation Mongolia's Central energy system.	Ph.D. thesis abstract		Russian	Accident regime, accident resistant automatic device, transmission network, reliable operation	2.22	Power

103	Hishigsaihan D.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2006	Hydrodynam- ics and internal heat exchange of twisted streams formed by multichannel axial swirlers of furnace burners	Ph.D. thesis abstract		Russian	Furnace burner, heat exchange, burning process	3.17	Heating
104	Hurlee D., Nyamdeleg Ch.	"Erdenet Heat and Power station" ТӨХК	2007	The present condi- tion of the central- ized heating supply in Erdenet, and urgent problems faced in its fur- ther renovation and development.	Article	8	Mon- golian	Heating supply, losses, Insulation, heating	3.18	Heating
105	Hurelbaatar Ch.	МР	2007	Present and future of fuel and energy sector.	Article	4	Mon- golian	Fuel, energy sec- tor, coal reserve, clean technology of coal, electricity supply, heat supply	1.33	General energy is- sues
106	МоЈНА, Min- istry of Fuel and Energy.	ЭБЭХЯ Tel: 261511	2007	Law of Mongolia on Energy: Program on Integrated power energy system of Mongolia.	Book	64	Mon- golian, English	Electricity pro- duction, electricity transmission, elec- tricity distribution, heat production, heat transmission, heat distribution, special license, regulated supply of energy, unregulated supply of energy	1.31	General energy is- sues

107	MoJHA, Ministry of Fuel and Energy.	ЭБЭХЯ Tel: 261511	2007	Collection of legal acts related to functions of Fuel, energy and power sector	Book	424	Mongolian	Energy, renewable energy system, electricity transmission line, energy regulation, program of activities, Energy regulation agency, Council of regulators	1.32	General energy issues
108	MoJHA, Ministry of Fuel and Energy.	ЭБЭХЯ Tel: 261511	2007	Law on Renewable Energy. National Program on renewable energy	Book	31	монгол, English англи	Renewable energy, renewable energy fund, prices and tariffs of renewable energy, renewable energy resources	4.18	Renewable energy
109	Huyagdorj M.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2005	Mathematic models of Mongolia's energy resources and their consumption.	Ph.D. thesis abstract		Mongolian	Energy resources, consumption, economic−mathematic macro model, statistic model, dynamic model, electric energy system	2.23	Power
110	Tseyenoidov J.	MUST, SPE www.must.edu.mn Tel:323579 Fax:323579	2007	Power production at Heat and power stations of the Central power system of Mongolia and natural environment.	Article	12	Mongolian	HPS, power system of the central region, individual expenditure of exemplar fuel, AYK, greenhouse gas, high−volatile coal, sulphuric acid, carbon monoxide, nitric oxide	6.11	Energy, environment, ecology

111	Tserenpurev S.	ЭБЭХЯ, Energy Agency Tel: 261511	2007	Innovation of information tech-nology in energy sector. Management Academy.	Ph.D. thesis abstract		Mon-golian	Information system of management, infor-mation technology, innovation, national dispatch center, cen-tral energy system	1.34	General energy is-sues
112	Tsetsgee S.	ERA, Tel: 319335 info@era.energy.mn www.rea.energy.mn	2007	Planning and regu-lating economi-cally sound energy production at initial stage of market relations.	Article	12	Mon-golian	Economically efficient planning of electricity production, econom-ically sound coordi-nation of dispatcher, relationship of coupled production, share of standard-ized fuel spending, real price and cost of electricity and heat.	1.35	General energy is-sues
113	Chimiddorj D., Ganbaatar B.	ЭБЭХЯ Tel: 261511	2009	Mongolia's state policy of fuel and energy	Article	5	Mon-golian	Fuel and energy sec-tor, strategic goal, priorities	1.36	General energy is-sues
114	Shwarzby John, Amarsanaa S.	EPRC Project Tavan Bogd Plaza, Ulaanbaatar, Tel: 321375 Fax:327825	2006	Public Education Strategy For Energy Sector Reform	Project study report	25	English	Public education, reform of energy sector, price and tariff, energy regulating agency	1.37	General energy is-sues
115	Enhbayar Sh.	ERINA http://www.erina.or.jp enkhee@erina.or.jp	2005	Opportunities for Pollution-Free Development: CDM Projects May Sure in Mongolia	Article	6	English	Climate changes, greenhouse gas, clean development mecha-nism, energy supply, energy consumption	6.12	Energy, environ-ment, ecology

116	Enebish N.	NCRE enebish@magicnet.mn	2008	Use of renewable energy is a ex− tremely important objective of sus− tainable develop− ment.	Article	6	Mon− golian	Sustainable devel− opment, renewable energy	4.19	Renewable energy
117	Erdenebaatar A.	NCRE	2008	Establishment of a wind park in Mon− golia	Article	11	Mon− golian	Renewable energy, wind park, wind en− ergy resources, wind resources distribution	4.20	Renewable energy
118	Erdenebat B.	MP, former Minister for Fuel and Energy	2009	Construction− foundation of growth (Fuel and energy policies and objec− tives)	Paper	8	Mon− golian	Fuel and energy sector, development policy, energy and power system, energy supply	1.38	General energy is− sues
119	Ministry of Min− erals and Energy, "Ulaanbaatar heating network" ТӨХК, Power Engineering School	"Ulaanbaatar Heating Network" JSC www.dhc.mn	2009	50 years of Mongo− lia's centralized heat supply system, its future prospects and tendencies.	Book	164	Mon− golian	Centralized heat supply, heat network, heat generation power station, heat condition	1.39	General energy is− sues
120	Energy Regula− tion Agency	ERA, Утас: 319335 info@era.energy.mn www.rea.energy.mn	2007	Energy statistical indicators 2008	Book	70	Mon− golian	Energy company, heat and power station, profit, loss, receiv− ables, state budget, subsidy, individual fuel consumption, sales income	1.40	General energy is− sues

121	Japan International Cooperation Agency	7F, Bodi Tower, Sukhbaatar Square 3, Ulaanbaatar, Tel: 325939 Fax: 310845 E-mail: jicamg@jica.go.jp	2000	Master Plan Study for Rural Power Supply by Renewable Energy in Mongolia. Final Report. Summary	Project report	98	English	Rural power supply, renewable energy, solar power generator, wind power generator, small hydropower station, fuel element, nitrogen production	4.21	Renewable energy
122	Japan International Cooperation Agency	7F, Bodi Tower, Sukhbaatar Square 3, Ulaanbaatar, Tel: 325939 Fax: 310845 E-mail: jicamg@jica.go.jp	1995	Study on Comprehensive Coal Development and Utilization in Mongolia. Final Report. Summary	Report	101	English	Coal, coal mine, master plan, quality monitoring system, air pollution	5.8	Fuel